

STATE OF ALASKA

*Jay S. Hammond, Governor*



Completion Report for

ESTUARINE REARING STUDY

Enhancement of Sport Fish Resources  
by the Fisheries Rehabilitation,  
Enhancement and Development Division

by

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# TABLE OF CONTENTS (Continued)

## Section R

Job No. AFS 41-4 Amendment 1 (continued)	Page No.
Taku River Egg Take	6
King Salmon River Egg Take	7
Andrews Creek Egg Take	8
Chikamin River Egg Take	8
Unuk River and Cripple Creek Egg Takes	12
Incubation and Hatchery Survival	12
Survival of Egg Lots to Eyed Stage	15
Egg Transport Survival	15
IHNV Analysis	18
Discussion	18
Literature Cited	19

## Section S

Study No. AFS 47-1		Page No.
Estuarine Rearing Study	Samuel Bertoni Jeff Hansen Harold <b>Heinkel</b>	
Abstract		1
Background		2
Recommendations		2
Objectives		3
Informal Objectives		3
Techniques Used		3
Fish Receipt		3
Growth and Survival		7
Grading		7
Monitoring Environmental Parameters		7
Adult Returns from 1975 Release of Coho Smolt from the Fish Creek Facility		7
Ripening and Spawning of Adult Coho at the Fish Creek Facility		8
Tagging and Release of Smolt		8
Net Pen Design		9
Antifouling Compounds		9
Findings		9
Results-Growth, Survival, and Food Conversion		9
Grading		39
Environmental Parameters		40
Recovery of Adult Salmon and Ripening Study		40
Tagging and Release of Smolt		58
New Net Pen Design		58
Antifouling Compounds		70

## TABLE OF CONTENTS (Continued)

### Section S

Study No. AFS 47-1 (continued)	Page No.
Discussion	70
Grading	70
Growth, Survival, and Food Conversions	71
New Net Pen Design	71
Antifouling Compounds	71
Literature Cited	71

## RESEARCH PROJECT SEGMENT

State: Alaska Name: Sport Fish Investigations  
of Alaska  
Project No.: F-9-9  
Study No.: AFS 47 Study Title: ESTUARINE REARING STUDY  
Job No.: AFS 47-1 Job Title: Estuarine Rearing Study  
Period Covered: May 15, 1976 to June 30, 1977

## ABSTRACT

Depleted stocks of king salmon, Oncorhynchus tshawytscha (Walbaum), and coho salmon, O. kisutch (Walbaum), in the Juneau area have prompted efforts to develop new methods of increasing salmon production. The purpose of this project was to develop a procedure for overwintering juvenile salmon in salt water then secondarily imprinting them to an estuarine rearing facility where they would return as adults. These fish could produce a viable egg source and a significant fishery in the Juneau area. Overwintering of subsmolts took place at the Fish Creek Estuarine Rearing Facility.

During the 1976-1977 operational year the average weight of overwintering coho increased from 12.3 grams to 19.8 grams between September 1 and April 13, and the mortality was 24%. During this time water temperature ranged from 2.3°C to 9.4°C and water salinity ranged from 14.0 ppt. to 29.5 ppt. Test lots of similar sized coho were tagged and released at different times to determine the affect of released timing on smolt to adult survival. Recovery of coded wire tagged adults released at 16 gms in 1975 indicated at least a 2.6% survival. Spawn from adult coho ripened and spawned at the facility had an 83% survival from egg to alevin stage. A comparison of mortality rates between lots of graded fish and several lots of fish which had not been graded demonstrated no significant differences. Conversion rates for dry and moist feeds were compared but the results were inconclusive. A trial application of copper antifouling paint to the pen nets was successful in that it reduced the necessity of net cleaning with no accompanying accumulation of copper in the fish within the treated nets.

## BACKGROUND

The status of the sport fishery salmon stocks overall is closely related to the status of the commercial salmon stocks. However, a major difference occurs in that stocks which are too low to provide for an adequate commercial harvest may provide for a limited sport fishery. An intense sport fishery is conducted in salt water adjacent to Juneau on king, coho and pink salmon, Oncorhynchus gorbuscha (Walbaum). Boats used in the fisheries range from 16 to 40 feet in length with 18 to 25 foot length boats the most popular. The majority of fishing trips are one day in length although some of the larger boats make overnight trips on weekends and holidays. The fishery commences in mid-April, reaches a peak in July and August then rapidly tapers off to its conclusion by the end of September. This localized pressure on reduced stocks identifies an immediate need for localized salmon enhancement.

The technique of estuarine rearing of salmonids in floating pens is in a process of evolution. It is presently in various stages of experimentation, development and pilot production in Japan, Europe, and the United States by governmental agencies and the private sector. Efforts by the National Marine Fisheries Service station at Little Port Walter, Alaska have served as the guideline for this project. At the Fish Creek Facility various designs have been analyzed, tested, changed or adapted to new and better designs suitable for Alaska. This station is continually monitoring trials on pen culture, and is collecting information required for developing culture conditions and conversion rates needed to efficiently produce healthy salmon smolts at an artificial facility. An active and current library on estuarine rearing is also part of the project.

The Fish Creek Estuarine Rearing Facility is located near Fish Creek approximately 10 miles north of the Douglas bridge on North Douglas Highway in the Juneau Borough, Alaska.

## RECOMMENDATIONS

1. Increase facility capacity to release 500,000 coho and/or king salmon smolt.
2. Design, construct and operate an efficient adult capture, ripening and spawning facility in the Fritz Cove area to process adult salmon returning to the Fish Creek Rearing Facility.
3. Apply antifouling paint to all pen nets and incorporate the modified Canadian design pen frame for new pens.
4. Evaluate utilization of dry feeds and mechanized feeders for production of salmon smolt.

5. Evaluate effect of fish grading upon smolt growth, food conversion and survival.

## OBJECTIVES

1. Develop the techniques for rearing king and coho salmon to smolts in one year while minimizing disease and mortalities within the estuarine facility.
2. Develop stocks of king and coho salmon which will return to the estuarine rearing facility with predictable regularity.
3. Develop methods for holding and ripening coho and king salmon with minimal mortalities prior to being artificially spawned.

### Informal Objectives

1. Provide king, Onchorynchus tshawytscha (Walbaum), and coho salmon, Onchorynchus kisutch (Walbaum) to the fisheries of the Juneau area.
2. Evaluate fish culture techniques for application to estuarine pen rearing in Southeastern Alaska by:
  - a. development of methods to keep net pens free of marine growth
  - b. incorporation of fish grading
  - c. development of criteria through which feeding regimes for penned fish may be established
  - d. evaluation of several net pen designs
3. Conduct an experimental rearing trial with rainbow trout, Salmo gairdneri (Richardson), at the estuarine rearing facility.
4. Document returns of adult coho to the rearing facility and to creeks in the immediate area of Fish Creek.

## TECHNIQUES USED

### Fish Receipt

During the first week of facility operation (Table 1), 99,439, 1975 Mendenhall River coho were received. These coho were incubated at the Crystal Lake Hatchery in Petersburg, Alaska, interim reared at the hatchery and subsequently transferred to the Mendenhall Rearing Ponds at Juneau in the spring of 1976. These fish were fed at the rearing ponds until transfer to the Fish Creek Facility. The fingerlings were seined from the Mendenhall Rearing Ponds, biomassed, loaded into a distribution truck and transported to the area of the estuarine rearing facility on Douglas Island. The fish were conveyed from the distribution tanks to floating pens through irrigation pipe (Figure 1). After the fish were in the net pen the pen was towed to the rearing facility.

Table 1: 1976-77 Fish Creek week of operation  
corresponding to date

WEEK	DATES
1	9/12-18/76
2	9/19-25
3	9/26-10/02/76
4	10/03-09
5	10/10-15
6	10/17-23
7	10/24-30
8	10/31-11/06/76
9	11/07-13
10	11/14-20
11	11/21-27
12	11/28-12/04/76
13	12/05-11
14	12/12-18
15	12/19-25
16	12/26/76-1/01/77
17	1/02-08
18	1/09-15
19	1/16-22
20	1/23-29
21	1/30-2/05/77
22	2/06-12
23	2/13-19
24	2/20-26
25	2/27-3/05/77
26	3/06-12
27	3/13-19
28	3/20-26
29	3/27-4/02/77
30	4/03-09
31	4/10-16
32	4/17-23
33	4/24-30
34	5/01-07/77
35	5/08-14
36	5/15-21
37	5/22-28
38	5/29-6/04/77

The maximum loading capacity of each of the ten 49m<sup>3</sup> net pens at Fish Creek is 392 kg of fish. The maximum loading density is 8.0 kg/m<sup>3</sup>. Thus the maximum capacity for the Fish Creek Estuarine Rearing Facility in September, 1976 was 3,920 kg of fish. Table 2 summarizes fish receipt information and lists pen stocking densities ranging from 2.8 to 5.6 kg/m<sup>3</sup>. Extensive size variation of the coho salmon was observed at the time of receipt and grading of the fish was planned to occur upon receipt of the grader ordered September 22, 1976. Because additional stress might increase mortalities and loading densities were well below the maximum limits, immediate redistribution was unwarranted.

Table 2: 1975-76 Fish Creek coho receipt data\*

<u>Pen Number</u>	<u>Arrival Date</u>	<u>Kg of Fish</u>	<u>Fish/kg</u>	<u>Total Fish</u>	<u>Density (kg/m<sup>3</sup>)</u>
1	9/16/76	261.47	61.42	16059	5.3
2	9/15/76	275.49	63.91	17605	5.6
3	9/16/76	271.59	63.34	17202	5.5
4	9/16/76	136.22	63.34	8628	2.8
5	9/17/76	247.18	72.44	17907	5.0
7	9/17/76	182.38	69.40	12657	3.7
8	9/17/76	<u>135.22</u>	<u>69.40</u>	<u>9384</u>	2.8
TOTAL		1509.55	65.87	99439	

\* Metric equivalent derived from measurements taken in English system.  
 "Total" line figures correct - pen data not additive due to conversion and rounding.

During the third week of operations, 8,931, 1976 Willamette rainbow trout arrived via distribution truck from Crystal Lake Hatchery. These fish were accepted for a rearing trial because the Fish Creek Facility was operating below capacity. Transfer of these rainbow trout, the 1975 Blind Slough coho and the 1976 Ship Creek king salmon received in May 1977 was similar to that described for the 1975 Mendenhall coho received in September, 1976.



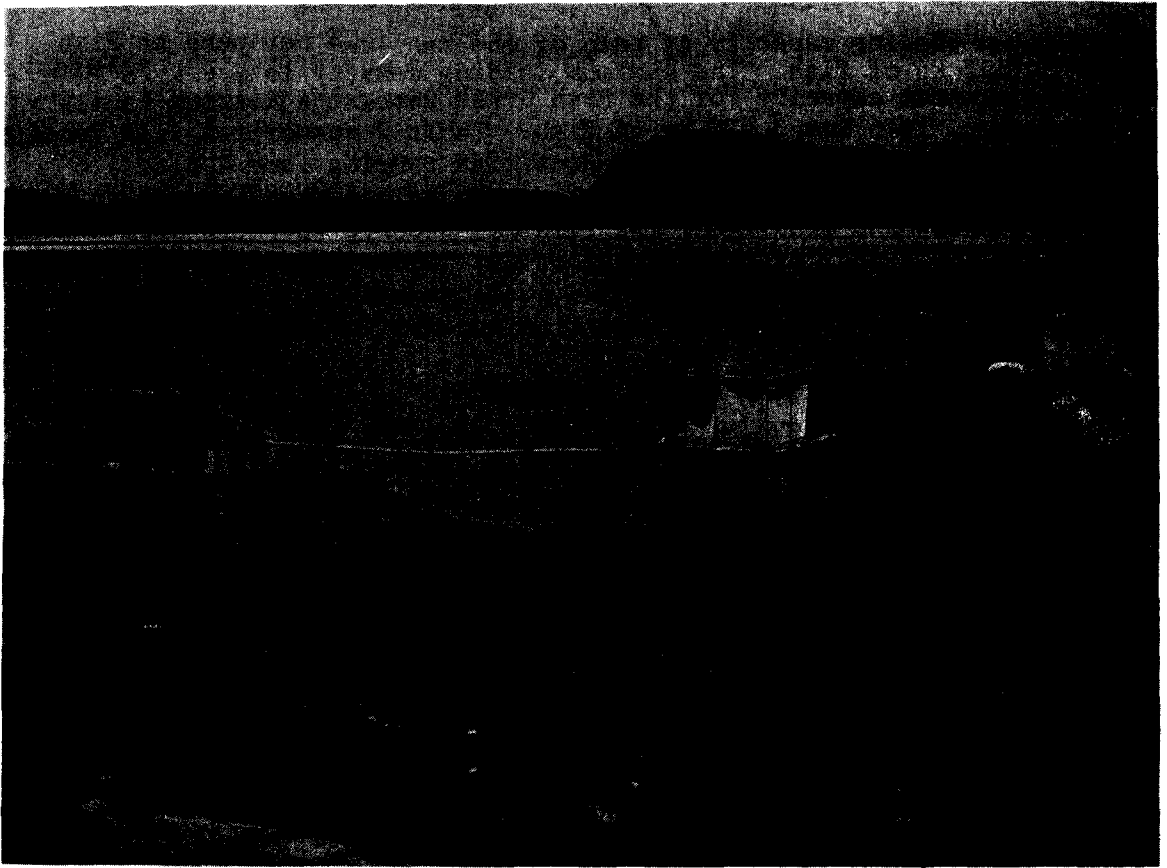


Figure 1: Piping fingerling from truck to net pen.

#### Feeding

1. Except for one experimental lot of coho, all fish were fed a diet of Oregon Moist Pellets (OMPII). One experimental lot was fed a dry diet of Clark's New Age Salmon Pellets 1/8". Both feeds are manufactured by the Moore-Clark Company.
2. Medicated food was fed only when prescribed by the Department fish pathologist. Medication of the food was accomplished by applying a powdered TM-50D (terramycin) in conjunction with gelatin as a dressing to the dry pellets.
3. The fish feed was kept a maximum of 120 days after manufacture. The OMP II is stored at  $-10^{\circ}\text{F}$  in the Juneau Cold Storage and the dry food is stored in a dry cool area at the State Support Building.
4. The daily ration for each fish lot was weighed daily (and thawed if necessary). The fish were fed seven days per week.

5. Fish were fed by "demand". Feeding was done at hourly intervals. If feeding activity continued through administration of the measured daily ration, more feed was administered. If feeding activity ceased before the measured daily ration was administered, the daily ration was lowered.

#### Growth and Survival

1. At the facility were weighing scales, measuring boards, dip nets of various sizes, anesthetic, and buckets.
2. Daily records were kept of the quantity and type of feed fed each lot of fish, the number of mortalities per pen and fork length of mortalities (fifty daily/lot maximum, ten weights per lot three days/week).
3. Monthly length and weight samples were taken of each lot of fish (three weight samples of 150 fish and one length frequency sample of fifty fish).
4. Pen loading was planned so as not to exceed  $8.0 \text{ kg/m}^3$  water at the time of release.

#### Grading

1. Grading was accomplished utilizing a Nielsen Model 5-0901 fish grader of standard manufacture during the 12th week of operation.
2. During the 26th week of operation, all fish from lot 2 were processed in the grader and replaced in pen #2. Subsequently, the mortality rate in this pen was compared to similar lots of coho which were not graded during week 26.

#### Monitoring Environmental Parameters

1. Daily measurements at the facility were made of water temperature and salinity utilizing a Yellow Springs Instrument Company, Model 33 salinity-conductivity-temperature meter.
2. Beginning in March, 1977, daily measurements of dissolved oxygen were made utilizing a Yellow Springs Instrument Company, Model 57 oxygen meter.
3. All measurements above were taken at 0.3, 1.0 and 3.0 meters below the water surface at 10:00 a.m. and 3:00 p.m. daily.

#### Adult Returns from 1975 Release of Coho Smolt from the Fish Creek Facility

1. An estimate of the minimum smolt to adult survival for 1972 and 1973

brood coho released from the Fish Creek Facility was obtained via the following:

- (a) stream surveys of limited scope conducted by the Alaska Department of Fish and Game in the Juneau area
- (b) catch sampling program at selected fish buying stations in Southeastern Alaska conducted by the Alaska Department of Fish and Game
- (c) creel census of the Juneau area sport fishery conducted by the Alaska Department of Fish and Game.

#### Ripening and Spawning of Adult Coho at the Fish Creek Facility

1. Fourteen coho adults captured with a gillnet fished from the rearing facility were tagged and held in one of the floating net pens.
2. The fish were periodically examined for ripeness.
3. Spawn was collected from ripened adults and transported to the Auke Creek Hatchery operated by the National Marine Fisheries Service in Juneau.
4. Eggs were fertilized utilizing the dry method and incubated to the alevin stage.

#### Tagging and Release of Smolt

1. All tagged fish were tagged with Northwest Marine Technology equipment. Tag retention was determined with a quality control device from the manufacturers.
2. Two lots 1975 Mendenhall coho having a similar history were assembled. The first lot (tag code 4-16-4) was released after tagging on April 20, 1977. The second lot (Tag code 4-16-6) was assembled with the intention of having a tagged lot of fish for release May 20, 1977 identical in length and weight to those released a month earlier. Comparison of returns from these lots will help determine the effect of timing of release upon survival.
3. One lot (tag code 4-16-5) of 1975 Mendenhall coho was assembled which was composed of individuals exhibiting obvious abnormalities. These fish were culled from all the lots of 1975 Mendenhall coho. Recoveries of fish from this lot will help project survival rates for similar fish.
4. All fish from the lot of largest 1975 Mendenhall coho obtained by grading were coded wire tagged (tag code 4-16-51).
5. All 1975 Mendenhall coho which were fed the dry diet were tagged before release (tag code 4-16-39).

6. Ten thousand of 31,000, 1975 Blind Slough coho released on May 16, 1977 were tagged (tag code 4-16-17). These fish were reared at Crystal Lake Hatchery to the smolt stage and received at the Fish Creek Facility on April 27, 1977 to be imprinted and released. Data from tag returns will be compared to coho over-wintered at the Fish Creek Facility.
7. All 1975 Blind Slough coho held for release July 20, 1977 were tagged (tag codes 4-16-52 and 4-16-53).
8. All 1976 Ship Creek king salmon smolt released on three dates in June were tagged (tag codes 4-17-5, 4-17-6, 4-17-7 and 4-16-41). These fish were reared to the smolt stage at Crystal Lake Hatchery before shipment to the Fish Creek Facility in June, 1977.

#### Net Pen Design

A new net supportive structure was tested in 1976-77 for comparison with the original net support structures. The new net support structure was adapted from a design of W.A. Kennedy (1975). The original structure supported the rearing nets with an aluminum cube shaped frame while the new design called for the nets to be supported by individual concrete corner weights.

#### Antifouling Compounds

A copper antifouling paint used to prevent growth of sessile organisms on pen nets was purchased from Tess Farming Systems, Stavanger, Norway, and applied to one rearing net for trial purposes. Ten litres of the compound without thinner were applied to one net. The fish cultured in the rearing net treated with the purchased antifouling paint were tested for copper content by an independent laboratory.

### FINDINGS

#### Results-Growth, Survival, and Food Conversion

Table 3 and Figures 2 and 3 show the survival data for the coho salmon through the 32nd week. The 3.76% weekly mortality in the first week of operation is assumed to be due to kidney disease (BKD) known to be present in the population. Table 4 and Figure 4 summarize the length and weight measurements taken through the 31st week of operation. Figure 5: A-G summarizes growth data by pen prior to the grading in the 12th week. Since grading redistributed all fish the integrity of each pen was lost. Figure 6: A-H summarizes length and weight data beginning the 14th week of operation and ending the 31st week.

Mortality samples throughout the rearing period indicate the average fork length (mm) of the dead fish is consistently lower than the fork length of all live fish sampled (Figures 5: A-G; 6: A-H; 7: A-G; 8: A-H). The report from the F.R.E.D. pathology laboratory in Anchorage of

Table 3: Survival data coho salmon\* Fish Creek 1976-77

Week of Operation	No. Fish Begin Week	Weekly Mortality	Cumulative Mortality	Weekly % Mortality	Cumulative % Mortality
1	99,439	3,737	3,737	3.76	3.76
2	95,702	637	4,374	.67	4.40
3	95,065	280	4,654	.29	4.68
4	94,785	237	4,891	.25	4.92
5	94,548	312	5,203	.33	5.23
6	94,236	306	5,509	.32	5.54
7	93,930	322	5,831	.34	5.86
8	93,608	542	6,373	.58	6.41
9	93,066	646	7,019	.69	7.06
10	92,420	556	7,575	.60	7.62
11	91,864	987	8,562	1.07	8.61
12	90,877	632	9,194	.70	9.25
13	90,245	754	9,948	.84	10.00
14	89,491	563	10,511	.63	10.57
15	88,928	554	11,065	.62	11.13
16	88,374	534	11,599	.60	11.66
17	87,840	1,130	12,729	1.29	12.80
18	86,710	797	13,526	.92	13.60
19	85,913	672	14,198	.78	14.28
20	85,241	878	15,076	1.03	15.16
21	84,363	630	15,706	.75	15.79
22	83,733	557	16,263	.67	16.35
23	83,176	838	17,101	1.01	17.20
24	82,338	799	17,900	.97	18.00
25	81,539	790	18,690	.97	18.80
26	80,749	791	19,481	.98	19.59
27	79,958	702	20,183	.88	20.30
28	79,256	649	20,832	.82	20.95
29	78,607	752	21,584	.96	21.71
30	77,855	756**	22,340	.95	22.45
31	77,099	560	22,900	.73	23.03
32	76,539	1,016	23,916	1.33	24.05

\* Arrived at the facility between September 15 and 18, 1976

\*\* Includes 13 fish used for tag checks

Table 4: Summary data-Fish Creek 1976-77 length and weight sampling of coho salmon

Week of Operation	Fish/kg	Weight/fish (g)	Length (mm)
9/1/76	81.6	12.3	95.1 (Mendenhall sample)
1 9/18	65.9	15.2	Not taken (Arrival Average)
4 10/8	58.6	17.1	109.9
8 11/4	55.1	18.1	114.9
12 12/4	51.8	19.3	Not taken
14 12/15	Not taken	Not taken	117.6
21 2/5/77	56.9	17.6	117.7
26 3/9	53.9	18.6	121.6
31 4/13	50.5	19.8	123.5

Table 5: Summary data-Fish Creek 1976-77  
length and weight sampling of rainbow trout

Week of Operation	Fish/kg	Weight/fish (g)	Length (mm)
3 (9/28 arrived)	87.7	11.4	95.0
4 (10/8)	80.7	12.4	93.8
8 (11/4)	57.5	17.4	108.0
14 (12/13/76)	49.8	20.1	113.8
21 (2/2/77)	43.2	23.2	124.1
26 (3/9)	37.7	26.5	128.2
31 (4/13)	29.1	34.4	140.3
33 (4/25)	25.1	39.8	142.4

September 17, 1976 indicated that of 50 mortalities shipped for examination all had metazoan eggs on the gills ("not enough to form a severe obstruction"), 32% were infected with BKD, 56% exhibited exophthalmia, and 14% had swollen abdomens caused by BKD lesions. Since nearly a third of the mortalities exhibited BKD it is assumed that many of the deaths in the first week are attributable to this. BKD is a chronic stress related disease; symptoms of BKD are exhibited most in times of stress. This point indicates that chronic disease coupled with stressful situations may be the major cause of mortality to the smaller than average fish.

Table 5 and Figure 9 summarize the length and weight of the trout from receipt until transfer to Sport Fish Division on April 25, 1977. Length and weight measurements were taken every 4-7 weeks at the facility. Measurements were not taken in January due to the high number of mortalities during that period in both the coho and trout populations. Table 6 and Figures 10 and 11 summarize survival data for the rainbow trout. Rainbow trout mortalities were attributed by the pathology laboratory to furunculosis (Aeromonas salmonicida) and stress induced by increasing salinities beginning the 13th and 14th weeks of operation (Table 7 and Figure 12).

The weekly mortality rate of rainbow trout was 6+ to 13+ percent during weeks 14-21 of operation. There was measureable growth recorded on the length-weight sample taken February 2, 1977 (Table 5 and Figure 9). During the same period the coho lot had .63 to 1.29 percent mortality/week (Table 3 and Figure 2). The length-weight samples for the coho population showed no increase in length and a decrease in weight (Table 4 and Figure 4).

Computation of food conversion (kg food fed/kg weight gain) data based on the total kilograms of fish produced at the facility proved to be an unsuitable means of determining growth exhibited by the fish. This is due in part to the 24.0% coho and 59.2% rainbow trout cumulative mortality. Table 8 summarizes data on the food conversions at Fish Creek based on (a) the total of kilograms of fish produced, (b) the weight gain on a per fish basis and (c) dry food fed coho on a per fish basis. Part A of Table 8 does not take into account any mortalities. Part B of Table 8 is divided into two parts: (1) coho and (2) rainbow trout. The coho portion of Part B is further subdivided into (1) prior to grading and (2) after grading. Part B takes into account mortalities that occurred from the beginning to the end of the periods listed. Fish size, growth data and mortality data were taken from Tables 3 and 4 for the coho and Tables 5 and 6 for the rainbow trout. Amounts of food fed were determined from Table 9. Food conversions after February 7, 1977, for the coho do not take into account the dry food fed to the experimental lot in pen #1. Conversion of the dry food fed was somewhat better than the moist food in coho (part C, Table 8), but this is not conclusive.

Table 6: Survival data rainbow trout\* Fish Creek 1976-77

Week of Operation	# Fish Begin Week	Observed Morts	Cumulative Morts	% Weekly Mortality	Cumulative % Mortality
3	8931	58	58	.65	.65
4	8873	4	62	.05	.69
5	8869	4	66	.05	.74
6	8865	1	67	.01	.75
7	8864	21	88	.24	.99
8	8843	31	119	.35	1.33
9	8812	30	149	.34	1.67
10	8782	53	202	.60	2.26
11	8729	85	287	.97	3.21
12	8644	23	310	.27	3.47
13	8621	193	503	2.24	5.63
14	8428	186	689	2.21	7.71
15	8242	280	969	3.40	10.85
16	7962	942	1911	11.83	21.40
17	7020	960	2871	13.68	32.15
18	6060	374	3245	6.17	36.33
19	5686	397	3642	6.98	40.78
20	5289	508	4150	9.60	46.47
21	4781	295	4445	6.17	49.77
22	4486	105	4550	2.34	50.95
23	4381	130	4680	2.97	52.40
24	4251	113	4793	2.66	53.67
25	4138	103	4896	2.49	54.82
26	4035	113	5009	2.80	56.09
27	3922	62	5071	1.58	56.78
28	3860	66	5137	1.71	57.52
29	3794	47	5184	1.24	58.05
30	3747	32	5216	.85	58.40
31	3715	29	5245	.78	58.73
32	3686	35	5280	.95	59.12
33	3651	9	5289	.25	59.22

\* Arrived at the facility September 28, 1976  
Released to Sport Fish April 25, 1977



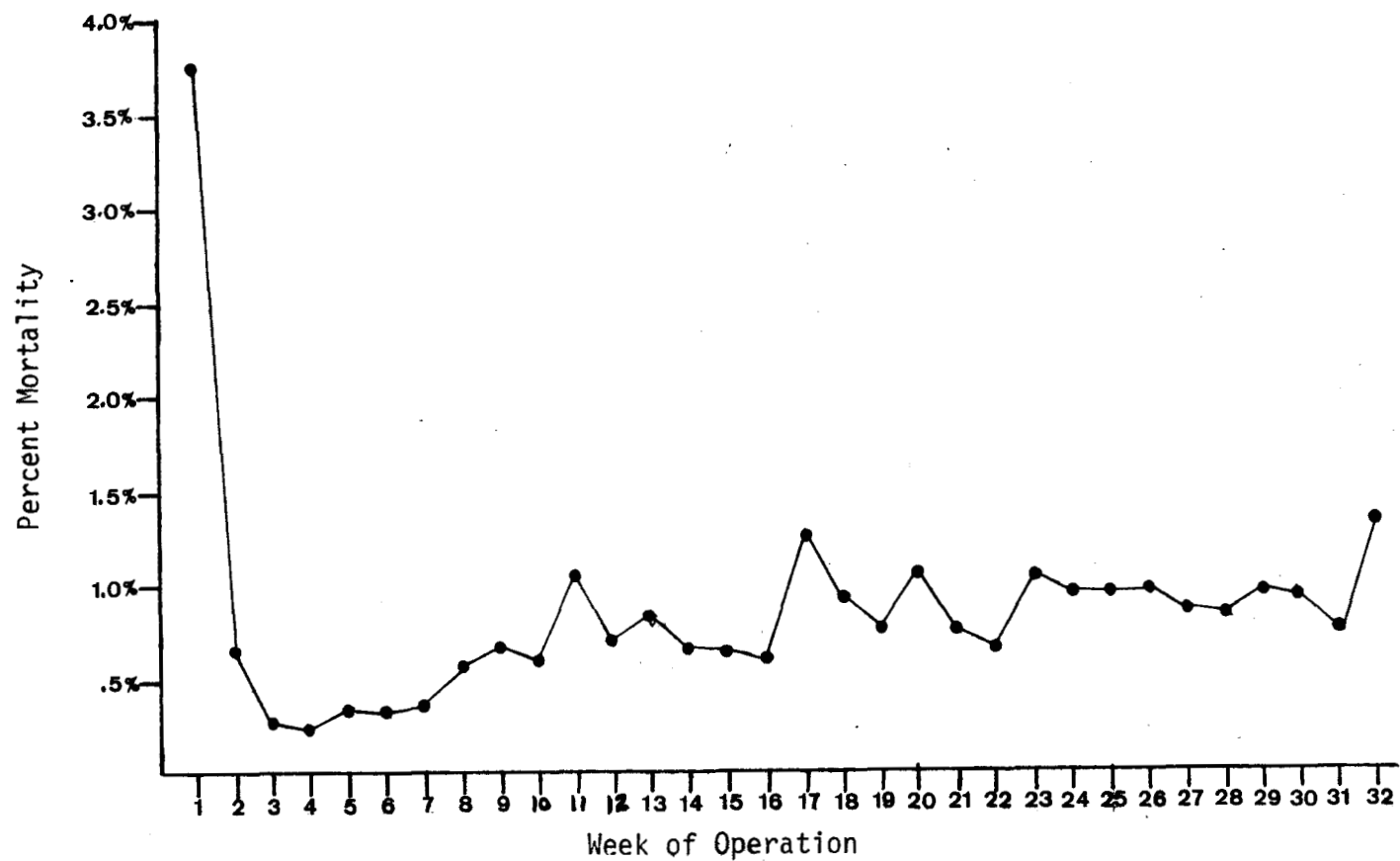


Figure 2: Coho salmon weekly percent mortality - Fish Creek 1976-77

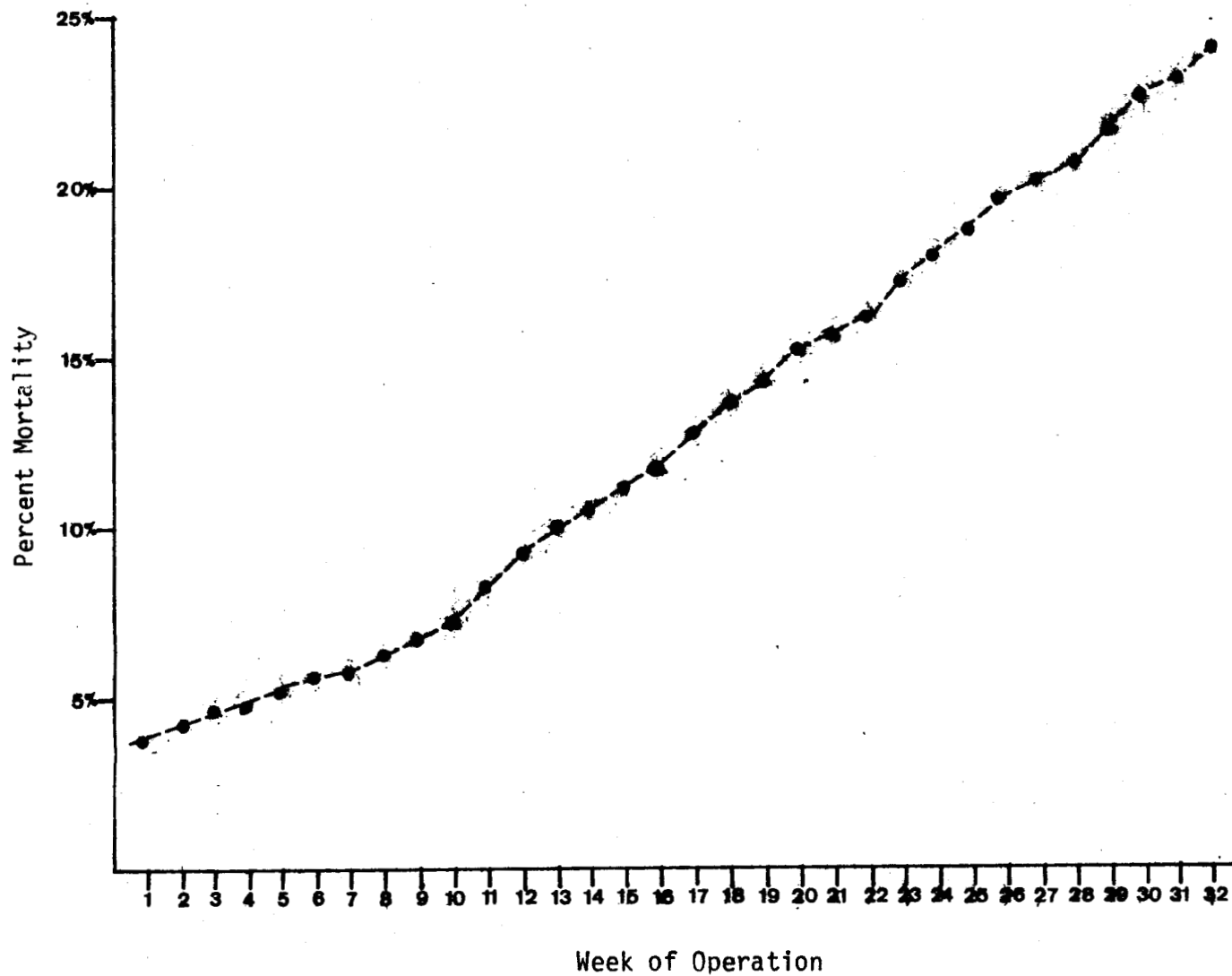


Figure 3: Coho salmon cumulative percent mortality - Fish Creek 1976-77

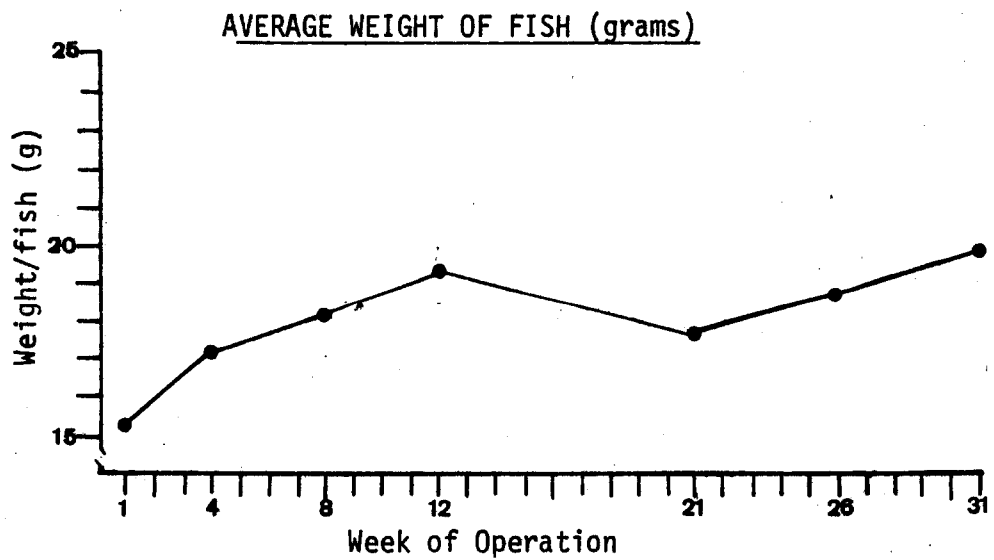
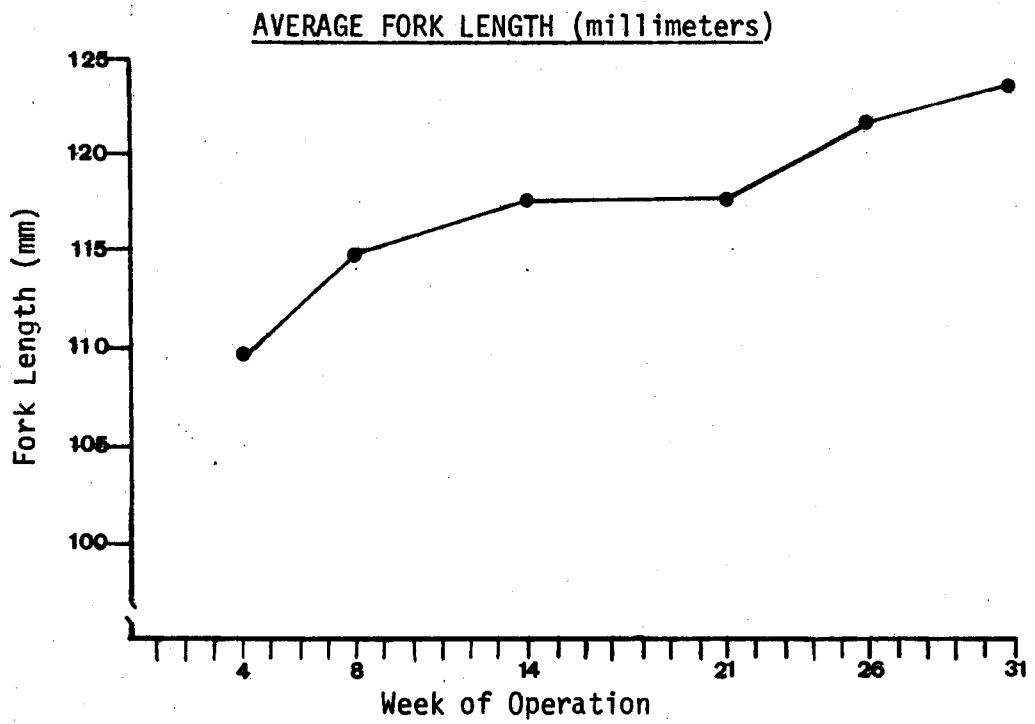
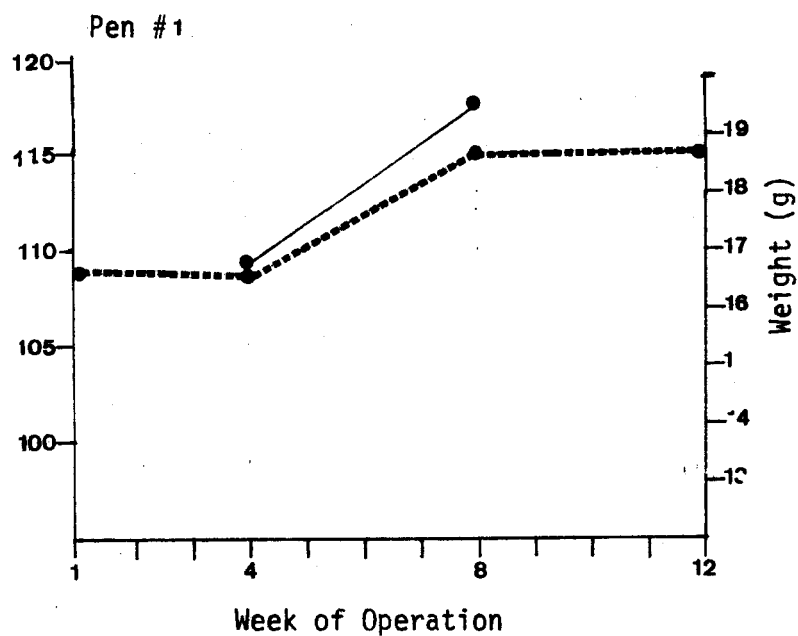


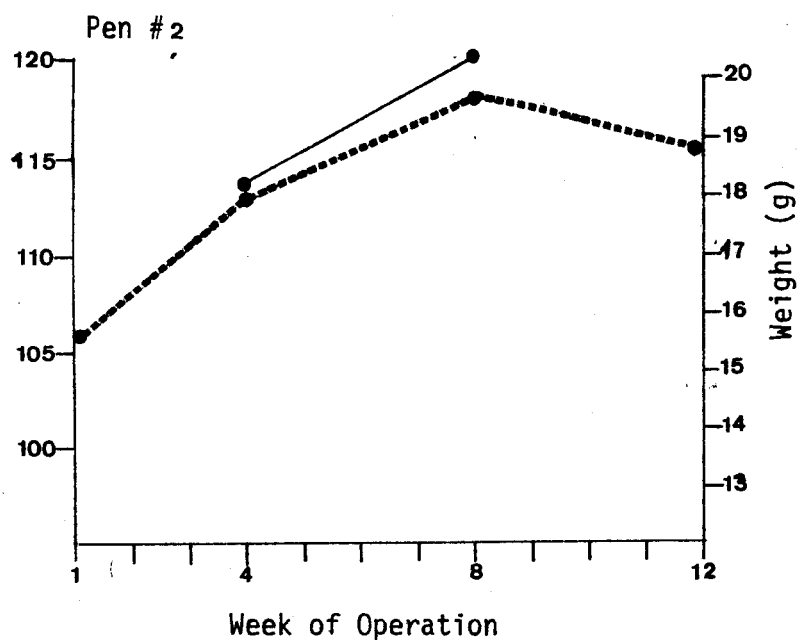
Figure 4: Coho salmon average fork length and average weight

Fork Length (mm)



weight	week	length
g		(mm)
16.3	1	*
16.3	4	109.
18.6	8	117.
18.6	12	*

Fork Length (mm)

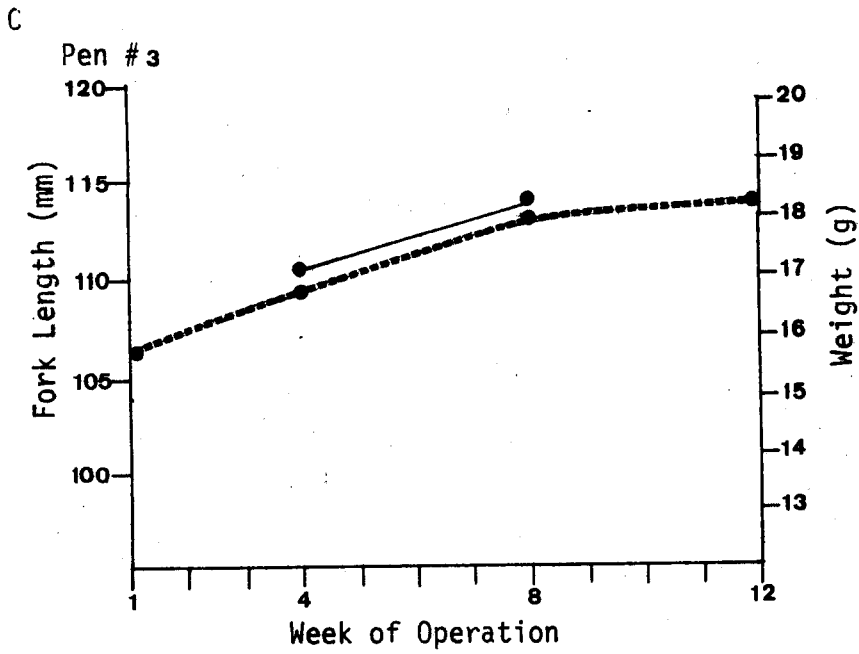


weight	week	length
g		mm
15.6	1	*
18.0	4	113.9
19.7	8	120.
18.8	12	*

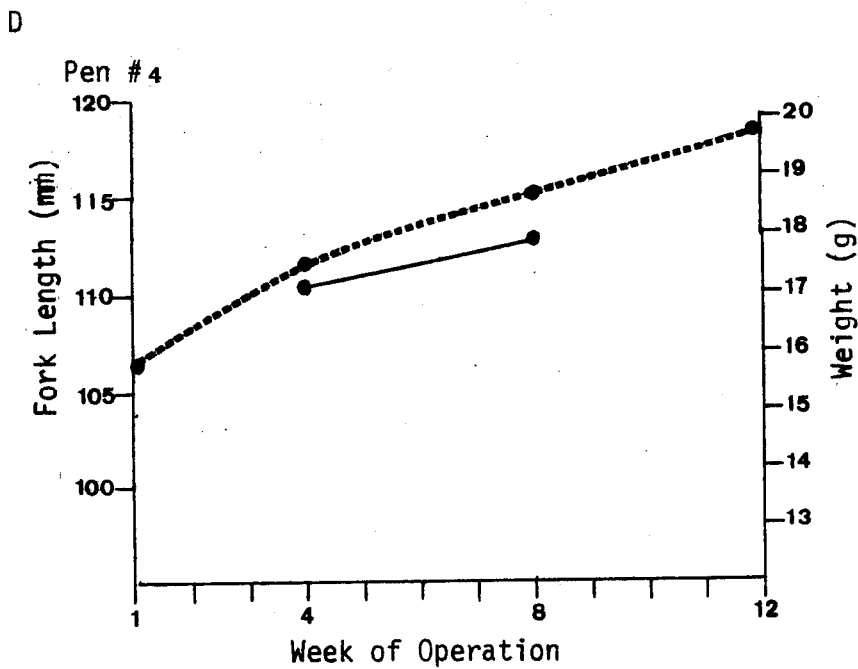
\* Not Taken

Figure 5: Coho salmon, Fish Creek 1976-77, Average fork length and average weight - weeks 1 through 12

..... Weight  
 — Length



weight g	week	length mm
15.8	1	*
16.8	4	110.3
18.0	8	114.0
18.2	12	*

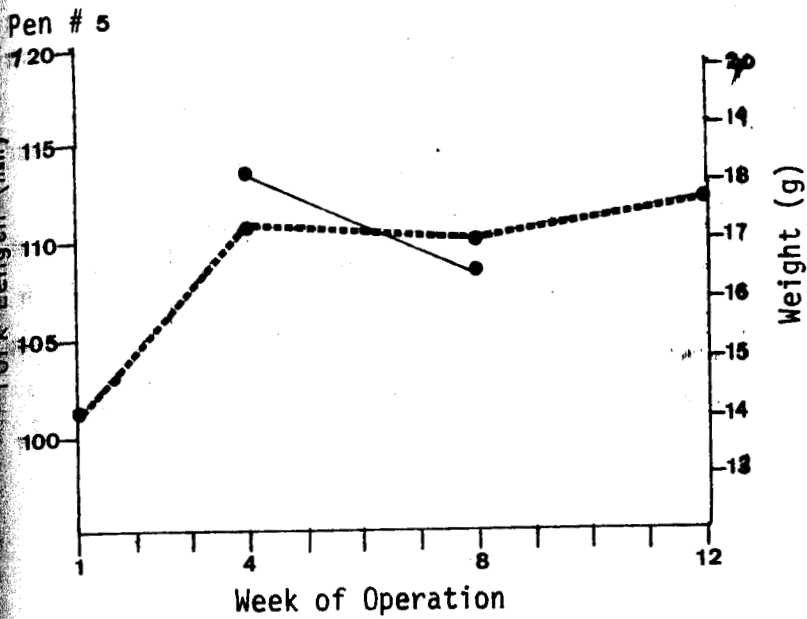


weight g	week	length mm
15.8	1	*
17.3	4	110.3
18.6	8	112.8
19.7	12	*

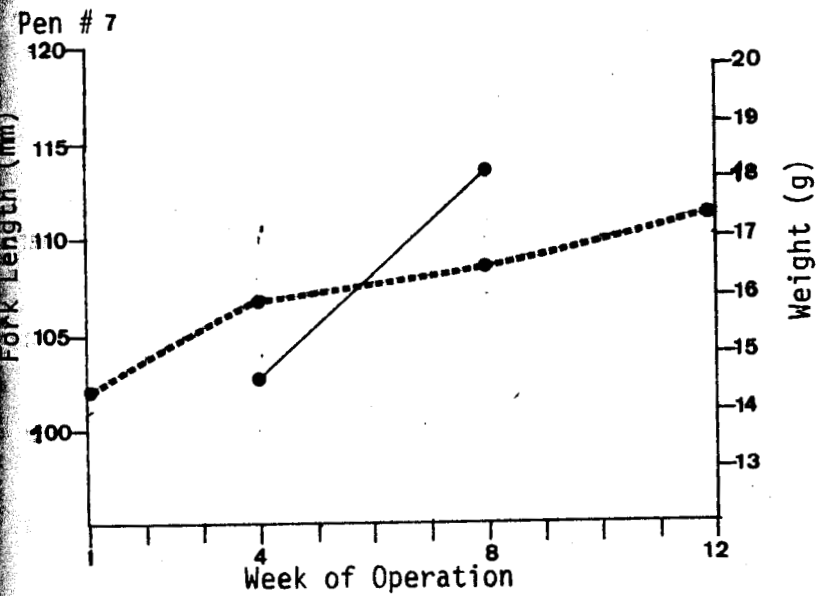
\*Not Taken

Figure 5: (con't) Coho salmon, Fish Creek 1976-77, Average fork length and average weight - weeks 1 through 12

----- Weight  
 — Length



weight g	week	length mm
13.8	1	*
17.2	4	113.5
17.0	8	108.5
17.6	12	*



weight g	week	length mm
14.4	1	*
15.9	4	102.9
16.5	8	113.2
17.3	12	*

\*Not Taken

Figure 5: (con't) Coho salmon, Fish Creek 1976-77, Average fork length and average weight - weeks 1 through 12

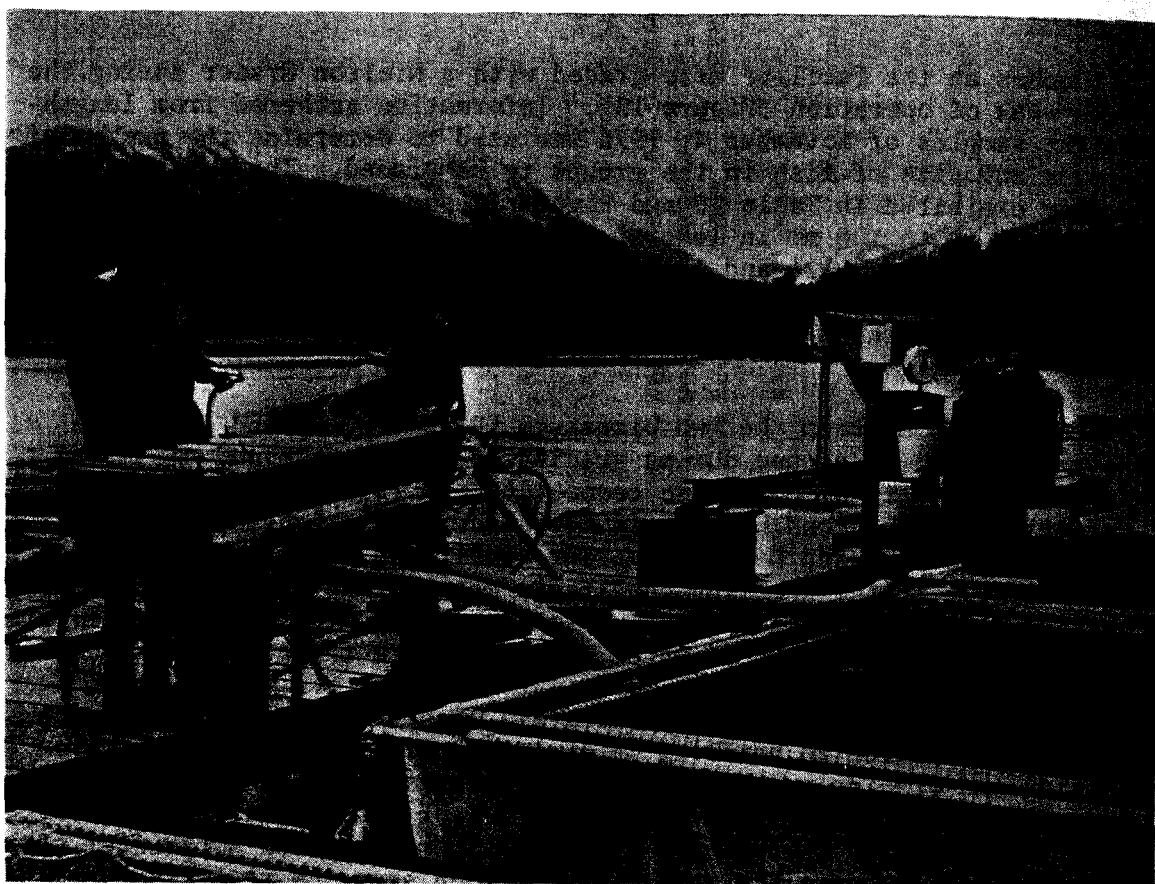


Figure 13: Biomassing and grading during good weather.

#### Environmental Parameters

Table 7 and Figures 12, 17, and 18 summarize temperature, salinity, and dissolved oxygen measurements from the 1st week of operation through the 35th week of operation. Salinities peaked during the 13th week, this was due to a decrease in fresh water runoff. This was expected since the facility is influenced by fresh water flow from the Mendenhall River and Fish Creek. Less runoff during extended periods of freezing temperatures causes higher salinities. Gaps in the charts are attributed to faulty instruments or instruments not on hand.

#### Recovery of Adult Salmon and Ripening Study

Tag recoveries for 1972 and 1973 brood coho reared at Fish Creek and returning as adults are summarized in Table 13. Table 13 encompasses recoveries of adults from the Fritz Cove and Mendenhall areas near Juneau. Table 14 indicates expanded numbers of returning adults based on the commercial troll harvest, escapement and the sport fishery. All

Table 8: 1976 - 77 Fish Creek food conversion data

## A. Food Conversions Based on Total Kilograms of Fish Produced.

	<u>No. Fish Beg. of Period</u>	<u>No. Fish End of Period</u>	<u>Size of Fish Beg. of Period</u>	<u>Size of Fish End of Period</u>	<u>Conversions/Period (kg food fed/kg wt gain)</u>
COHO	99,439(wk#1)	76,539(wk#31)	65.9 fish/kg 109.9 mm lgth. 15.2 gms/fish	50.5 fish/kg 123.5 mm lgth. 19.8 gms/fish	710.8:1
RBT*	8,931(wk#3)	3,642(wk#33)	87.7 fish/kg 95.0 mm/lgth. 11.4 gms/fish	25.1 fish/kg 142.4 mm/lgth. 39.8 gms/fish	10.4:1

## B. Food Conversions Based on a Per Fish Basis.

	<u>Prior to Grading</u>		<u>Food Conversion</u>
COHO	September 18, 1976 to October 8, 1976	8, 1976	3.8
	October 8, 1976 to November 4, 1976	4, 1976	10.8
	November 4, 1976 to December 4, 1976	4, 1976	8.2
	<u>After Grading</u>		
	December 4, 1976 to February 5, 1977	5, 1977	not determined
	February 5, 1977 to March 9, 1977	9, 1977	7.5
	March 9, 1977 to April 13, 1977	13, 1977	6.5
RBT*	September 18, 1976 to October 8, 1976	8, 1976	2.8
	October 8, 1976 to November 4, 1976	4, 1976	2.1
	November 4, 1976 to December 13, 1976	13, 1976	5.0
	December 13, 1976 to February 2, 1977	2, 1977	4.4



Table 8: (Con't) 1976 - 77 Fish Creek food conversion data

<u>After Grading</u>				<u>Food Conversion</u>
February	2, 1977 to March	9, 1977		2.0
March	9, 1977 to April	13, 1977		2.7
April	13, 1977 to April	25, 1977		.9

C. Food Conversions Based on a Per Fish Basis for Dried Food Fed Fish.

COHO	February	1, 1977 to March	8, 1977	5.8
	March	8, 1977 to April	12, 1977	5.4
	April	12, 1977 to May	20, 1977	1.5

---

\* Rainbow trout

Table 9: 1976 - 77 Fish Creek food fed data

Week of Operation	Kg Food Fed Coho Salmon *	Week of Operation	Kg Food Fed Rainbow Trout
1	47.4	3	9.3
2	206.4	4	18.4
3	243.2	5	21.8
4	250.3	6	25.4
5	277.3	7	25.4
6	261.6	8	25.4
7	255.8	9	25.2
8	260.4	10	25.4
9	249.5	11	19.7
10	245.8	12	24.0
11	180.9	13	15.4
12	164.4	14	9.3
13	110.0	15	8.6
14	93.5	16	18.4
15	82.0	17	21.5
16	122.1	18	14.4
17	125.4	19	7.2
18	123.6	20	8.4
19	103.2	21	8.4
20	114.5	22	9.2
21	116.2	23	11.2
22	117.8	24	11.2
23	116.5	25	11.2
24	115.0	26	10.7
25	116.5	27	11.2
26	112.1	28	11.2
27	116.7	29	11.2
28	115.9	30	11.2
29	114.4	31	9.3
30	110.1	32	11.2
31	93.7	33	1.6

\* Includes dry food fed to experimental lot (Pen #1).

Table 10: Fish Creek coho-1976  
length frequency distribution  
of the November 4, 1976, sample  
(all pen's combined) n=1,118

Fork Length (mm)	Distribution %
66- 70	0.3
71- 75	0.2
76- 80	0.4
81- 85	1.3
86- 90	1.1
91- 95	2.9
96-100	5.5
101-105	11.2
106-110	14.7
111-115	15.9
116-120	16.7
121-125	11.7
126-130	7.4
131-135	5.6
136-140	3.1
141-145	1.2
146-150	0.4
151-155	0.2
156-160	0.1
161-165	
166-170	
171-175	0.1
176-180	
Total 100.0	

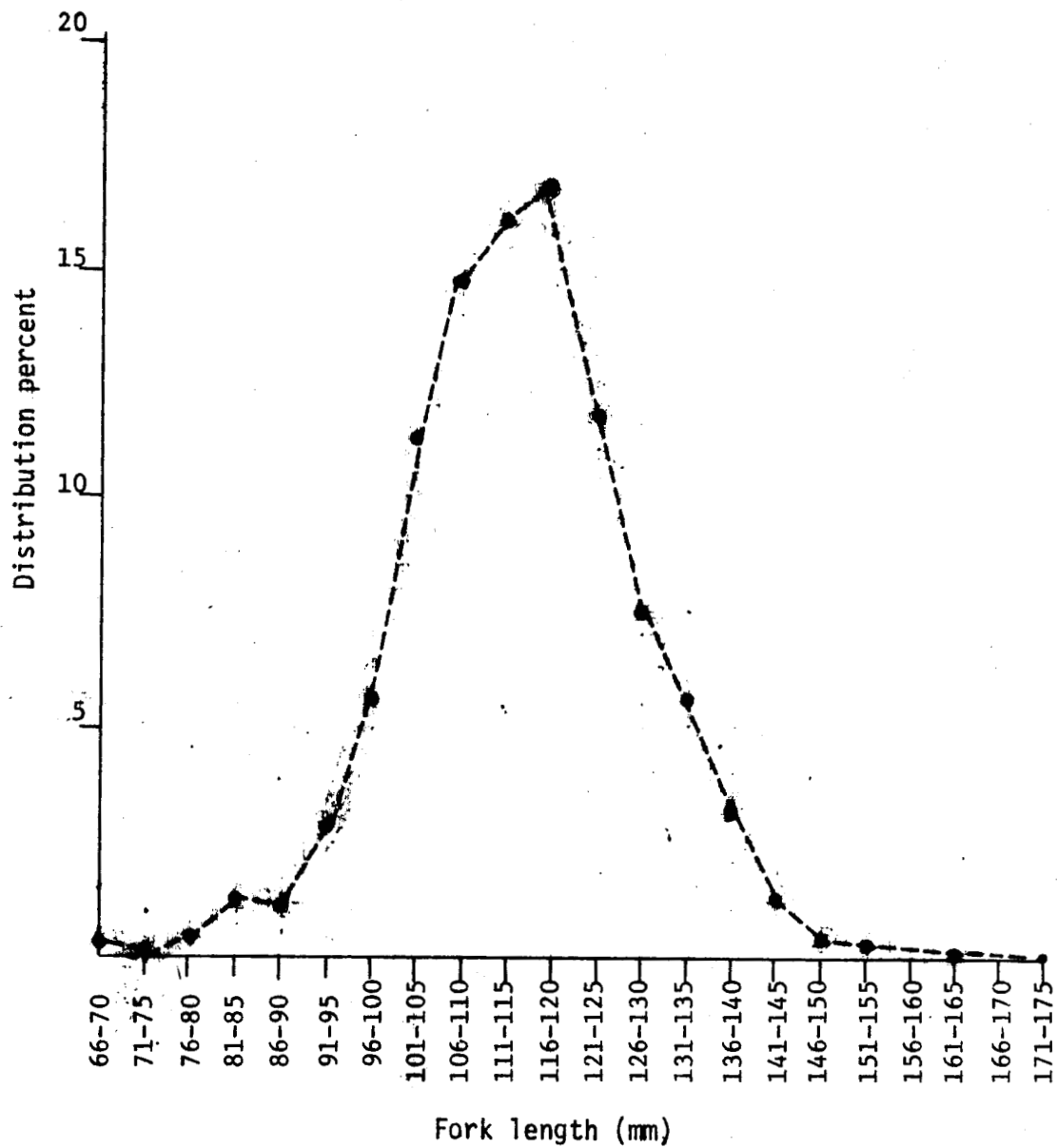


Figure 14: 1976 Fish Creek length frequency distribution of the November 4, 1976 sample distribution of the November 7, 1976 sample

Table 11: Biomass data by pen prior to and after grading-12th and 14th weeks of operation

Prior To Grading

<u>Pen</u>	<u>Kg Fish/Pen</u>	<u>Average Fish Size (Fish/kg)</u>	<u>Standard Deviation (lengths mm)</u>	<u>Density (kg/m<sup>3</sup>)</u>
1	314.2	53.8	12.8	6.4
2	327.8	53.1	11.2	6.7
3	327.0	54.9	11.4	6.7
4	166.6	50.7	11.7	3.4
5	295.2	56.9	14.7	6.0
7	203.9	57.8	12.7	4.2
8	135.4	58.4	12.4	2.8
9	<u>empty</u>	<u>empty</u>	<u>empty</u>	<u>empty</u>
Total	1770.1	54.9*		

After Grading

1	211.0	51.4	9.5	4.3
2	209.6	51.4	10.8	4.3
3	209.9	51.4	9.1	4.3
4	209.3	51.4	8.3	4.3
5	210.1	51.4	9.6	4.3
7	199.8	77.6	9.1	4.1
8	209.7	51.4	8.4	4.3
9	<u>266.7</u>	<u>35.1</u>	<u>12.1</u>	<u>5.5</u>
Total	1726.1	51.8*		

\* weighted average

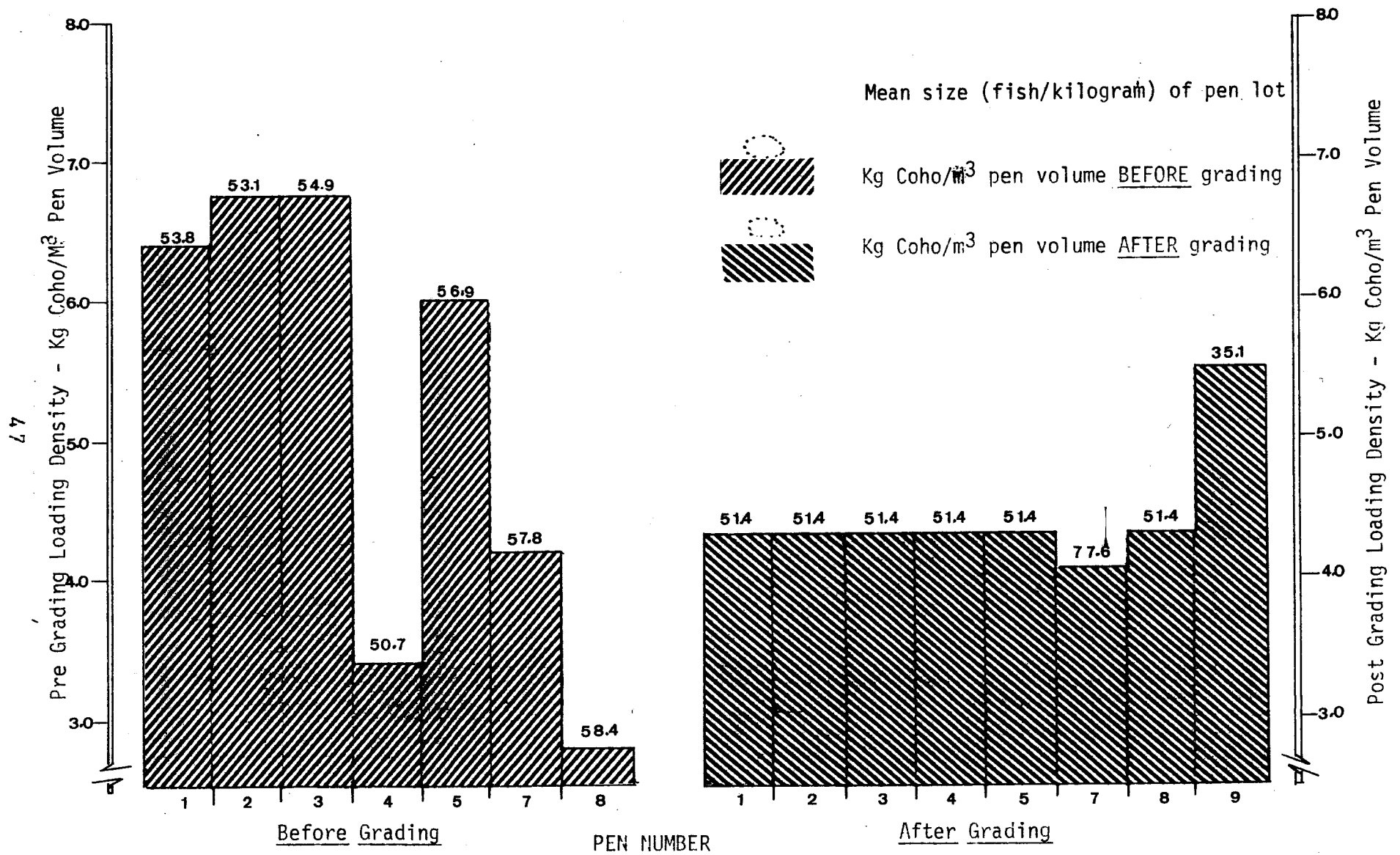


Figure 15: Loading density and mean fork length of coho by pen before and after grading

Table 12: Coho salmon-Fish Creek 1976-77 percent mortality per week by pen

Week	Pen#1	Pen#2	Pen#3	Pen#4	Pen#5	Pen#7	Pen#8	Pen#9
14	0.50	0.69	0.74	0.58	0.31	1.33	0.29	0.26
15	0.81	0.57	0.63	0.45	0.52	1.11	0.48	0.14
16	0.64	0.59	0.58	0.53	0.61	1.11	0.34	0.19
17	1.25	1.04	1.22	1.30	1.19	2.42	0.93	0.36
18	0.94	1.02	0.46	1.10	0.94	1.31	0.85	0.51
19	0.99	0.76	0.59	1.02	0.76	0.86	0.80	0.30
20	1.06	1.04	0.84	1.23	1.38	0.81	1.01	0.76
21	0.90	0.44	0.37	0.79	0.74	1.08	1.05	0.46
22	0.90	0.59	0.53	0.77	0.68	0.80	0.35	0.64
23	1.40	0.88	0.88	1.20	1.10	0.95	0.82	0.88
24	0.87	0.97	1.00	1.07	1.13	1.25	0.63	0.72
25	1.02	1.12	0.71	1.21	1.05	1.08	0.67	0.84
26	1.12	1.10	1.00	1.19	0.93	1.02	0.63	0.84
27	1.18	0.93	0.82	1.01	0.80	0.98	0.57	0.69
28	0.98	0.79	0.72	0.99	0.75	1.00	0.63	0.59
29	1.25	1.27	0.89	0.89	0.93	1.03	0.71	0.62
30	0.97	0.90	1.00	0.70	1.29	0.85	0.99	0.84
31	1.33	0.46	1.32	0.55	1.04	1.05	0.68	0.39
32	1.50	0.95	released	1.17	released	1.03	0.68	0.57
33	0.46	0.73		0.24		1.10	0.91	0.73
34	0.45	mixed		mixed		released	0.91	0.34
35	no data	released		released			mixed	released

Mixed: Fish redistributed so that pen identity was lost and therefore any future mortalities cannot be attributed to a special pen lot.

Released: Fish released into Fritz Cove (except lot # 7 which was given to Sport Fish 4/26/77)

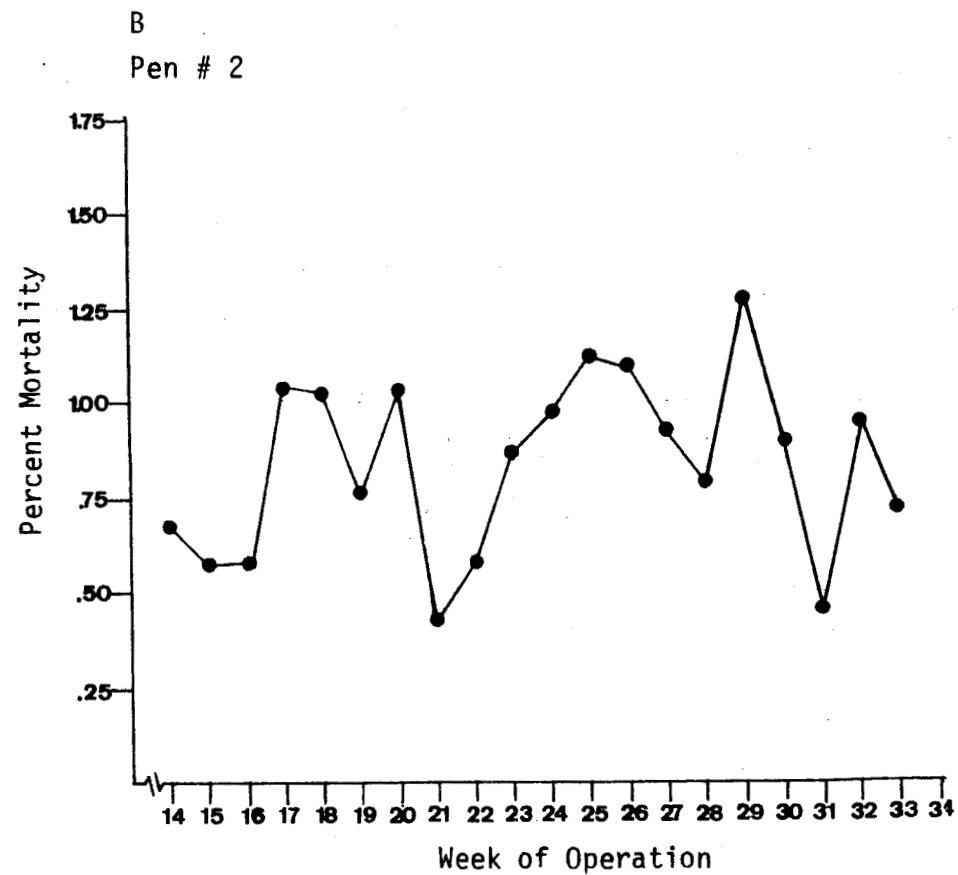
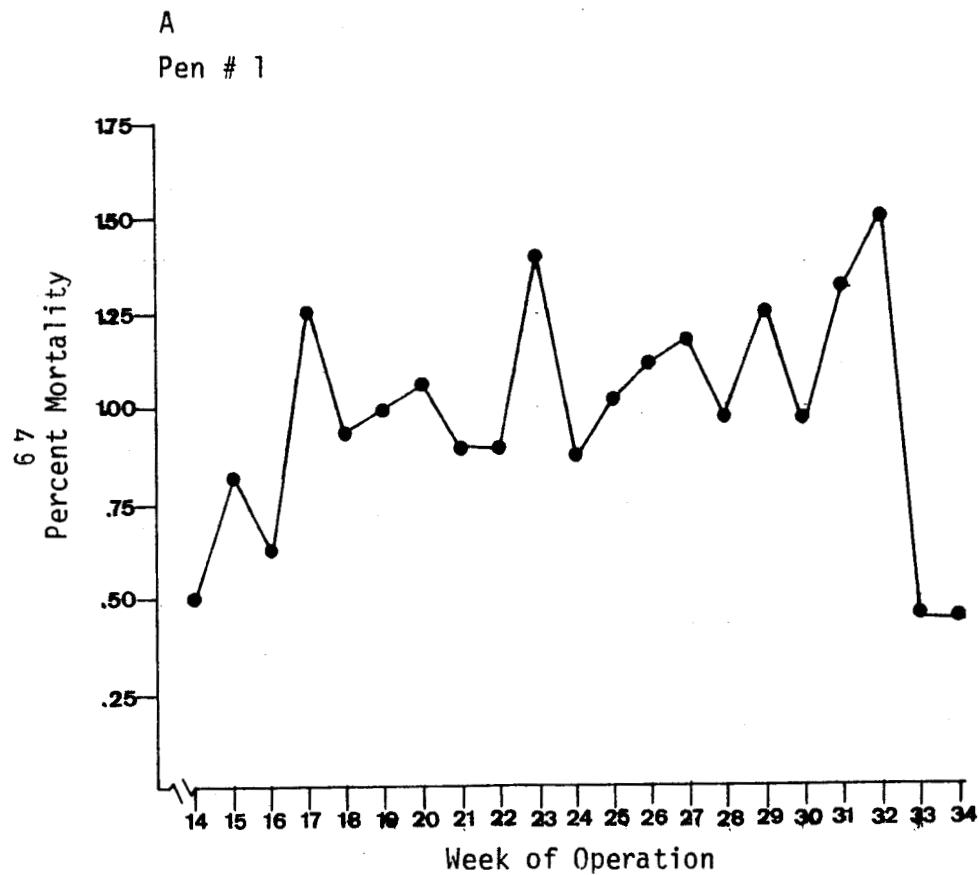
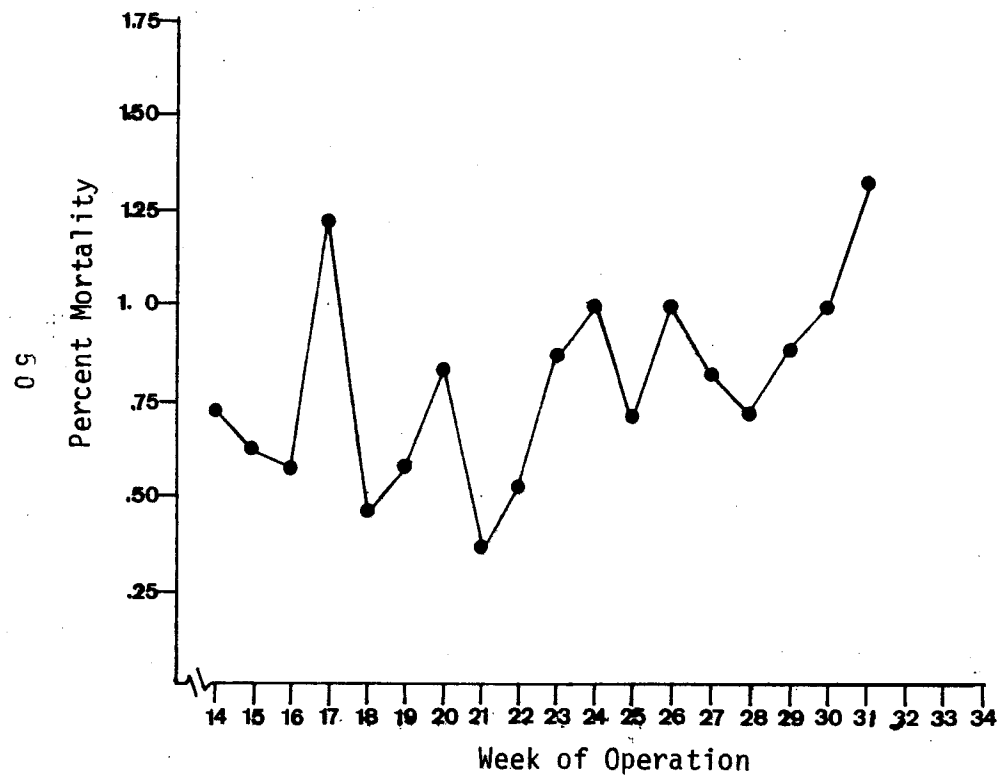


Figure 16: Coho salmon percent mortality per week, Fish Creek 1976-77



C

Pen # 3



D

Pen # 4

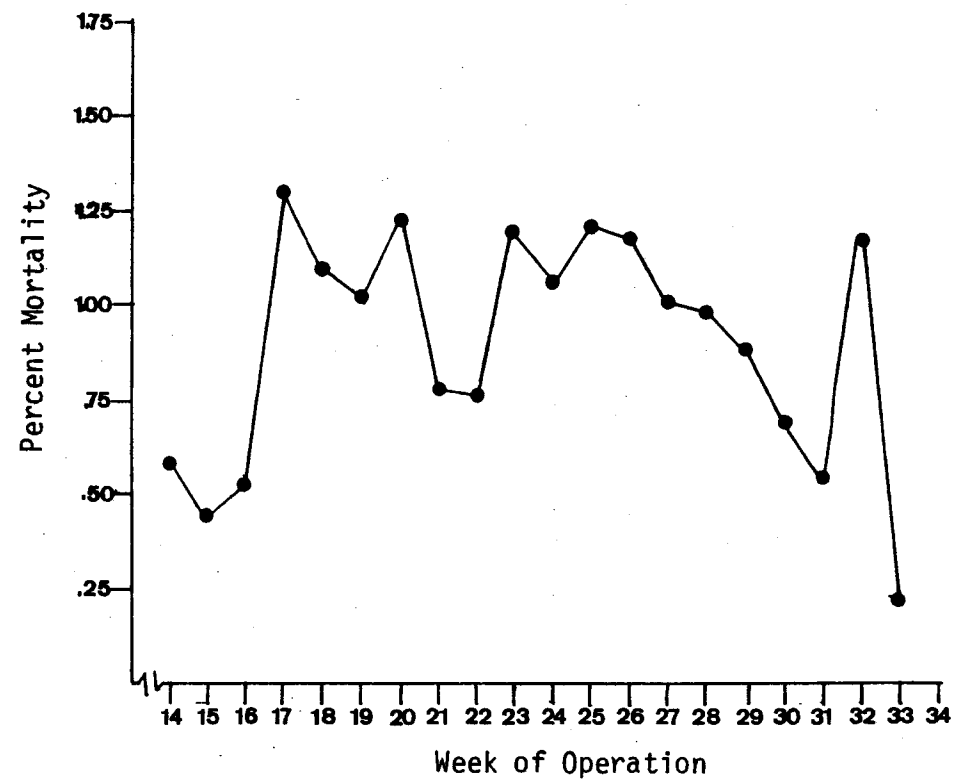


Figure 16: (con't) Coho salmon percent mortality per week, Fish Creek 1976-77

E

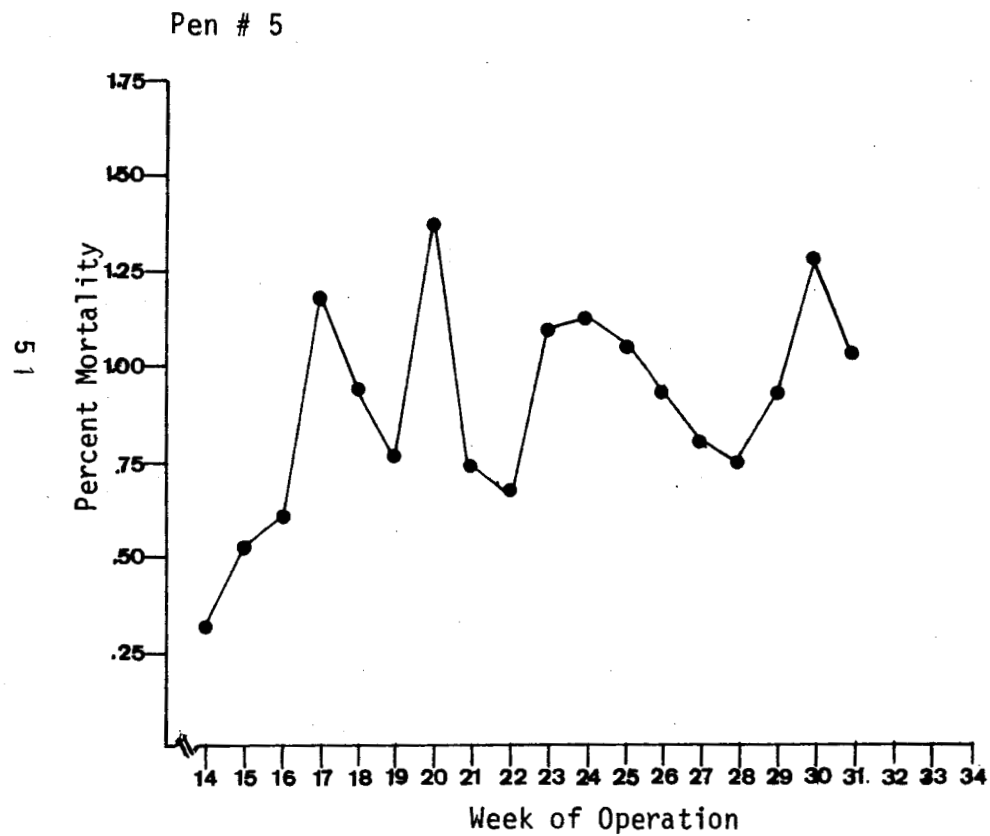
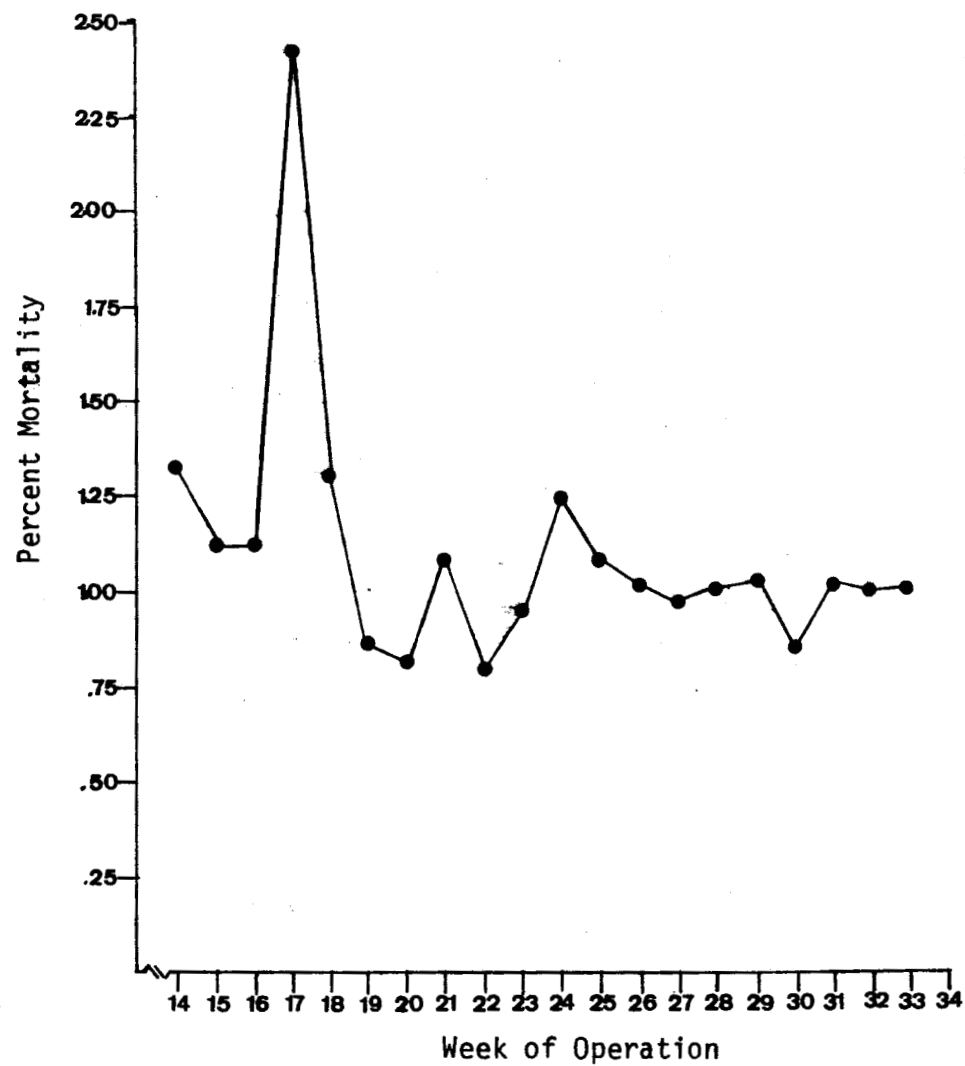
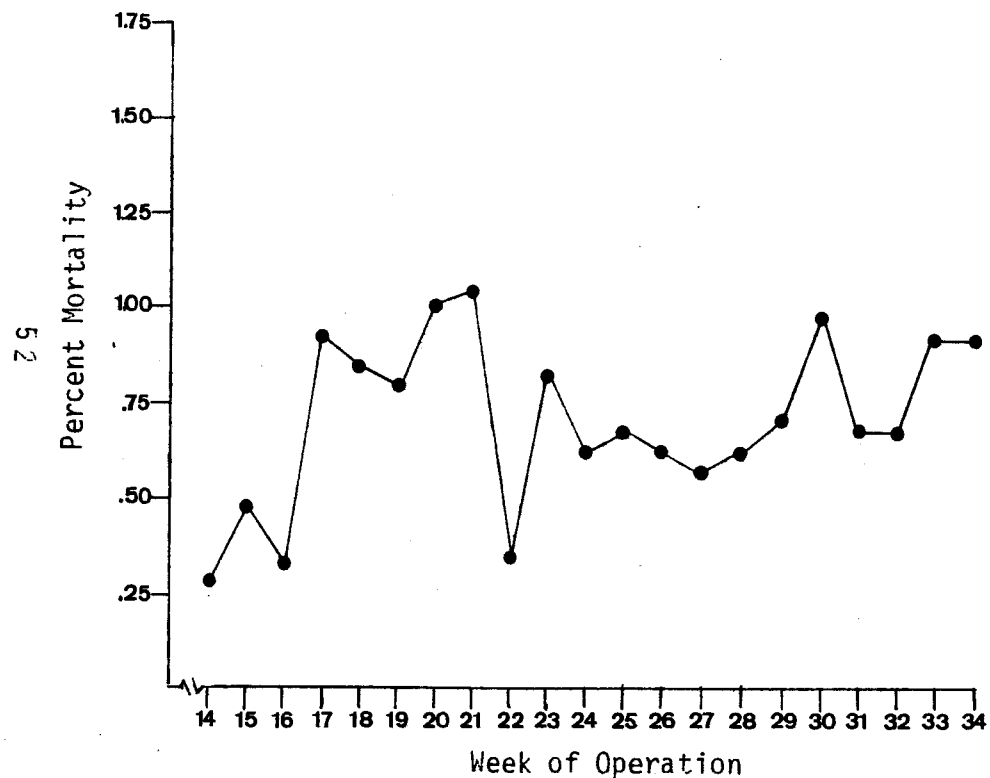
F  
Pen # 7

Figure 16: (con't) Coho salmon percent mortality per week, Fish Creek 1976-77

G

Pen # 8



H

Pen # 9

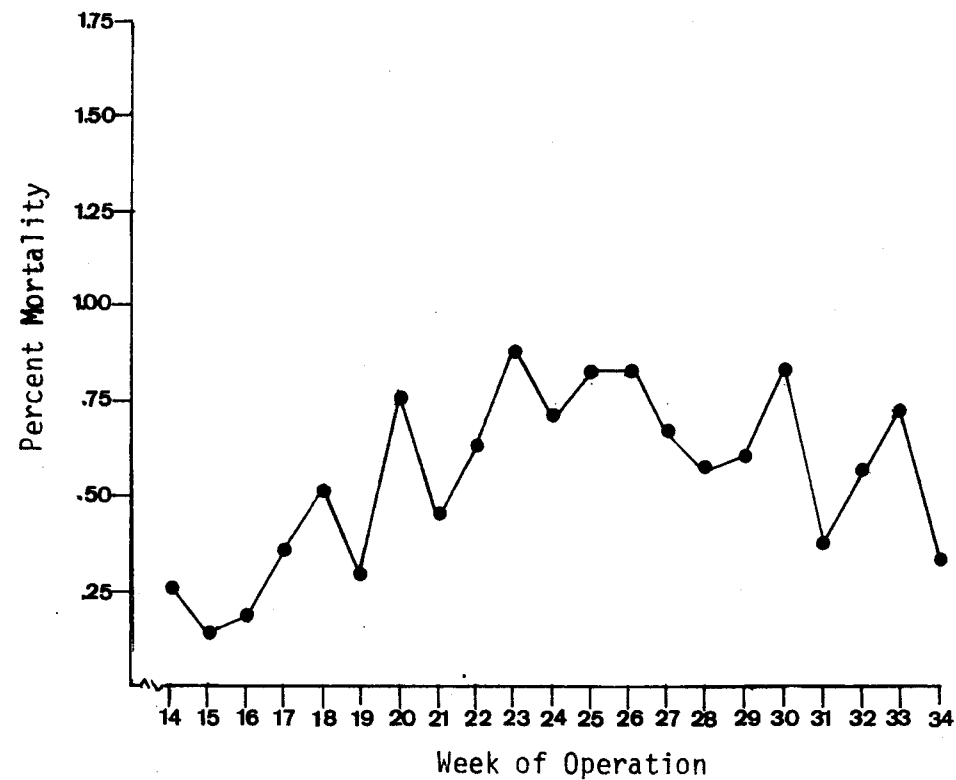


Figure 16: (con't) Coho salmon percent mortality per week, Fish Creek 1976-77

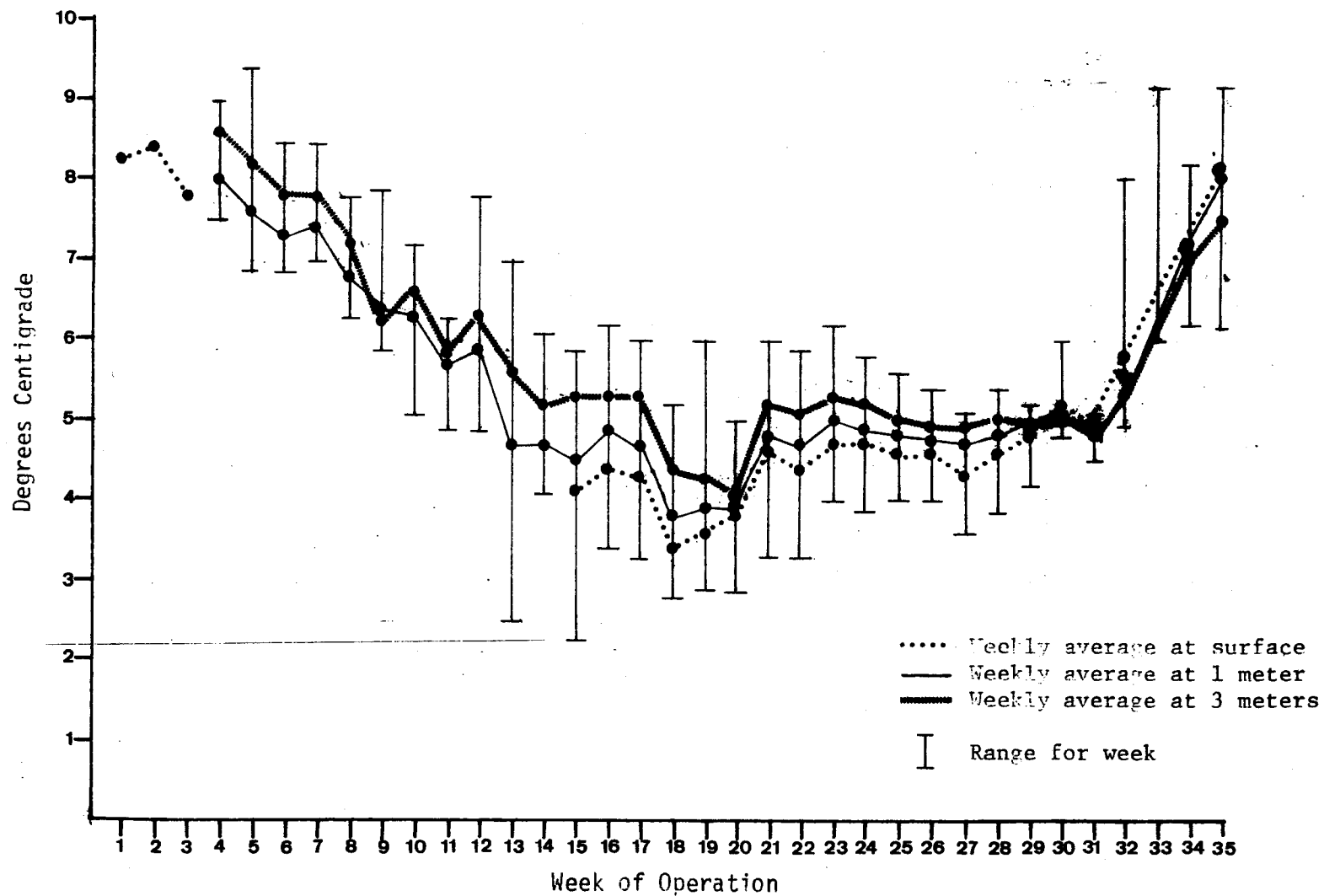


Figure 17: Fish Creek data, 1976-77 - Temperature ( $^{\circ}$  C)

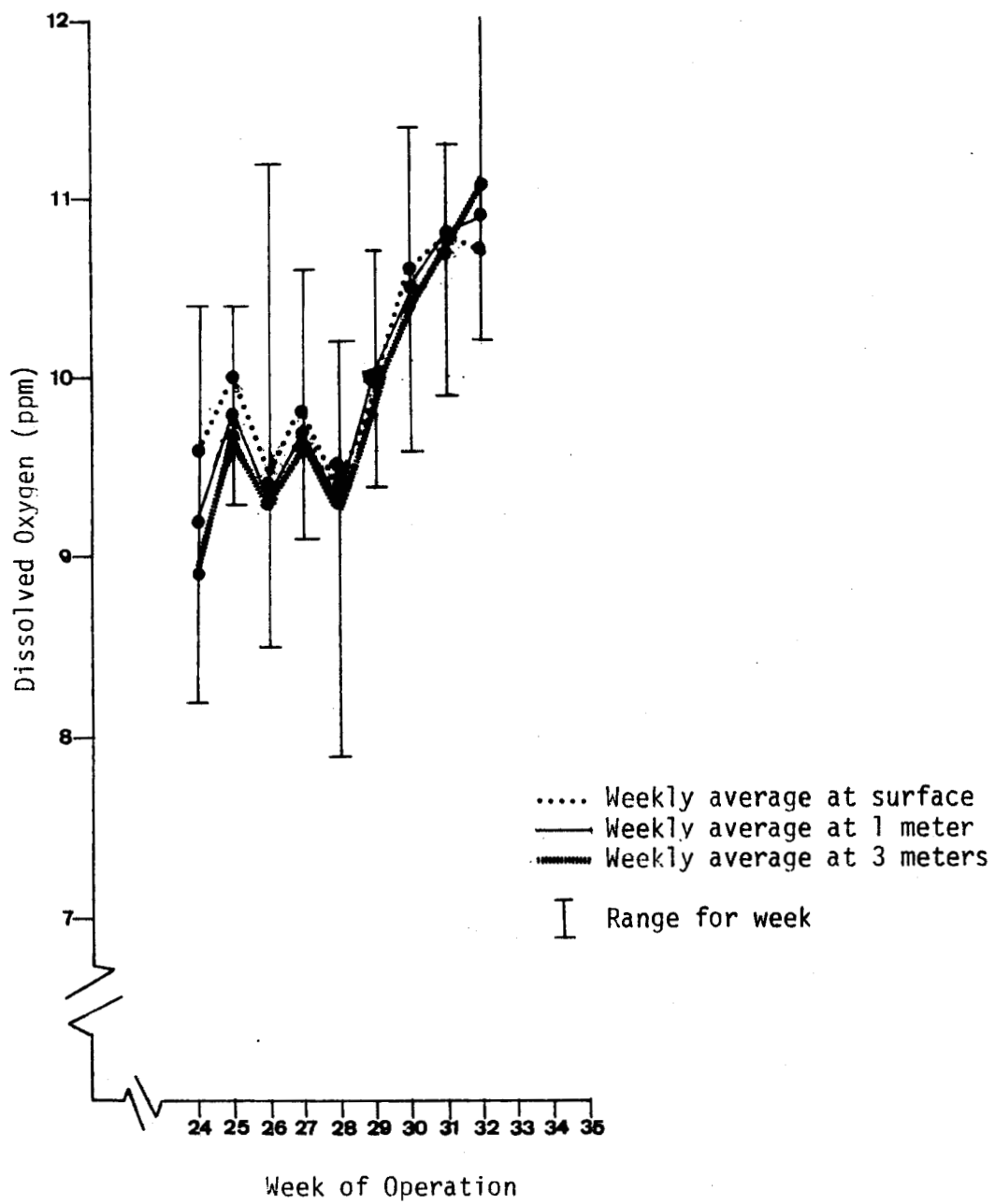


Figure 18: Fish Creek data, 1976-77 - Dissolved Oxygen (ppm)

Table 13: 1976 tag recoveries of Fish Creek coho salmon in the Juneau area

Date	Place	Code	No.	Sex
Sept. 15, 1976	Point Lena	4-2-12*	(1)	Male
Sept. 9-29, 1976	Auke Creek Weir	4-4-15**	(3)	Jack
		4-5-01***	(3)	Jack
Oct. 20, 1976	Fish Creek	4-2-12	(2)	Female
		4-2-12	(1)	Male
		4-2-13****	(1)	Male
		4-4-15	(1)	Jack
Oct. 21, 1976	Fish Creek	N.T.	(3)	Female
		N.T.	(1)	Male
		4-2-12	(1)	Female
		4-2-12	(2)	Male
		4-2-13	(1)	Male
Oct. 22, 1976	Fish Creek Pens	4-2-12	(3)	Female
		4-2-12	(2)	Male
		4-2-13	(1)	Female
Oct. 24, 1976	Fish Creek	4-2-12	(1)	Female
Oct. 29, 1976	Mendenhall Ponds	4-2-12	(2)	Female
	Fish Creek Pens	4-2-12	(2)	Female
		4-2-12	(1)	Male
		4-2-13	(1)	Female
		4-2-13	(1)	Male
Nov. 1, 1976	Fish Creek-Creek A	4-2-12	(3)	Female
		Unreadable	(1)	Female
Nov. 3, 1976	Fish Creek-Creek B	4-2-12	(5)	Female
		4-2-12	(2)	Male
		4-2-13	(2)	Female
	Peterson Creek	4-2-12	(2)	Unknown
		4-2-13	(1)	Unknown
		4-4-15	(1)	Jack
Nov. 4, 1976	Mendenhall Ponds	4-2-12	(5)	Female
		4-2-12	(6)	Male
Nov. 5, 1976	Fish Creek	4-2-12	(1)	Female
	Fish Creek-Creek A	4-4-15	(2)	Jack
		4-5-01	(1)	Jack
		N.T.	(1)	Jack
Nov. 9, 1976	Mendenhall Ponds	4-2-12	(6)	Female
		4-2-12	(5)	Male
		4-5-01	(1)	Jack
Nov. 11, 1976	Fish Creek	4-2-12	(2)	Female
		4-2-13	(1)	Female
		N.T.	(1)	Female
Nov. 12, 1976	Fish Creek-Creek B	4-2-12	(3)	Female
	Fish Creek-Creek B	4-2-12	(1)	Male
		4-4-15	(1)	Jack
	Fish Creek	4-2-13	(1)	Female
		N.T.	(1)	Female
		N.T.	(3)	Male

Table 13: (Con't) 1976 tag recoveries of Fish Creek coho salmon in the Juneau area

Date	Place	Code	No.	Sex
Nov. 16, 1976	Mendenhall Ponds	4-2-12	(1)	Male
	Floy Tag	00524Y	(1)	Female
Nov. 23, 1976	Steep Creek	4-2-12	(1)	Unknown
	Fish Creek	4-2-13	(1)	Female
		4-2-13	(1)	Unknown
		N.T.	(2)	Unknown
Dec. 12, 1976	Mendenhall Pond	4-2-12	(1)	Female

Notes:

1. Creeks A & B are at 8.6 Mile North Douglas Highway.
2. N.T. means no tag.
3. Unknown sex is because of decomposed fish and only heads could be recovered.
- . All adult Fish Creek codes recovered from Mendenhall Ponds were 4-2-12.
5. Summary of preceeding data on tag recoveries:

Sex	Number Recovered	Code
Jacks	5	4-5-01
	8	4-4-15
Female	37	4-2-12
	7	4-2-13
Male	22	4-2-12
	3	4-2-13
Unknown	3	4-2-12
	3	4-2-13

Total readable tags recovered 87

Recovered Floy Tags

Female (Floy Tag 00524)	1	None
-------------------------	---	------

- \* 1972 Brood Year
- \*\* 1974 Brood Year
- \*\*\* 1974 Brood Year
- \*\*\*\* 1973 Brood Year

Table 14: Cwt recoveries from coho salmon released at Fish Creek during 1975 and 1976 through May 30, 1977

CODE	BROODSTOCK	Commercial Troll		ESCAPEMENT		SPORT FISHERY		TOTAL	
		HARVEST							
		Actual	Expanded <sup>1)</sup>	Actual	Expanded <sup>2)</sup>	Actual	Expanded <sup>3)</sup>	Actual	Expanded <sup>4)</sup>
4-2-12	1972 Dredge Lake	160	322	63	77			223	399
4-2-13	1973 Blind Slough	121	224	12	13	1	5	134	242
4-4-15	1974 Blind Slough	1	2	11	11			12	13
4-5-01	1974 Blind Slough			9	9			9	9
TOTAL		282	464	95	110	1	5	378	663

1) From Commercial Fisheries Division troll fishery sampling program 1976.

2) Expanded number equals (total release/tagged release) times recoveries but for "jack" recoveries an additional factor of 1/2 is applied.

3) From Sport Fisheries Division Juneau area creel census.

4) "Jacks" as follows: 4-2-12 (1), 4-4-15 (all) and 4-5-1 (all).



recoveries in Table 13 are included under escapement in Table 14. Table 15 summarizes data on all adult fish captured by gill net at the Fish Creek Facility. Table 16 indicates which adults from Table 15 were held for ripening in salt water for the ripening study. Table 17 indicates survival of eggs taken from adults ripened in salt water.

#### Tagging and Release of Smolt

Tagging proceeded as planned, and all test lots were tagged with coded wire tags as listed in the techniques section of this report. Table 18 summarizes lot release information for Fish Creek in 1977. Total coho smolt released numbered 119,115. Of these coho 75,820 were tagged. Of the 88,607 king salmon smolt released, 85,317 were tagged.

Quality control measures were instituted each day to maintain proper tag placement. This is necessary to insure recovery of the coded wire tags from these fish. A sample from each lot of tagged fish was passed through the quality control device to determine tag retention for the lot (refer to footnotes Table 18).

To insure that fish of similar size are released on dates 30 days apart, growth projections for all nine pens of coho were made in mid-March. Table 19 summarizes actual and predicted fork lengths (mm) for all coho. Regular sampling dates did not correspond with the dates predicted for (April 20 and May 20) however, samples taken April 12 are listed on the table. The sample of April 12 indicated how accurate projections made in mid-March were and if any revision would be needed. From the March 9 sample and projected growths it was decided to adipose clip and coded wire tag (Ad/Cwt) all fish from pens #3, #4 and #5 for the April 20 release that were between 120 mm and 140 mm. Fish released on April 20 were Ad/CWT on April 4-7 and averaged 131.1 mm fork length. Pens #2, #8 and part of #4 were used for the May 20 release. The 120 mm-140 mm fork length interval used for the April 20 release was reduced to 120 mm-135 mm for the May 20 release in consideration of the warmer than expected salt water temperatures that contributed to the extra 6 mm growth shown in pen #8 three weeks after the sample of April 12 (see Table 19). This was necessary to insure that fish of similar size were released.

Jacks from the 1975 brood coho can be expected this fall in the Juneau area, however, adults will not return until the fall of 1978. The majority of king salmon adults are expected to return in 1978-80.

#### New Net Pen Design

The original facility was designed with ten aluminum supportive structures (Figure 19) for the rearing nets. This net and frame structure is designed to be suspended from a 17 x 17 foot collar of creosoted lumber and styrofoam logs (Figure 20). The aluminum frames cost approximately \$1,500 each and the flotation collars cost approximately \$1,600 per unit. Due to extensive corrosion and electrolysis (Figures 21 and 22) after 6-10 months of use in saltwater, repair costs averaging over \$200 per aluminum frame were necessary before the frames could be used beginning in September, 1976. Presently a modification of a Canadian design

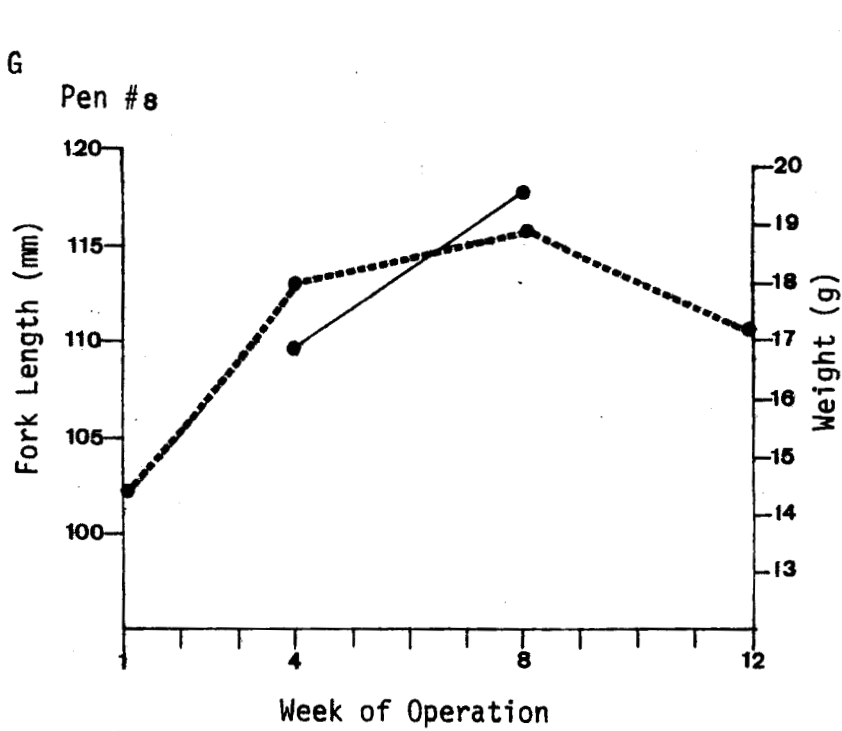
Table 15: 1976 Fish Creek gill net catch summary

Date	Tide	Set Time	Time Caught	#Fish	Sex	Markings	Floy Tag#	Disposition
9/27	Low 10:57 am	11:30 am	3:30 pm	2		NO DATA	NO DATA	released 9/29
10/2	High 10:55 am	9:30 am	12:30 pm	1	F	Ad. clip	00448	released 10/5
10/5	High 1:26 pm	10:30 am	2:30 pm	3	F	None	00450	released 10/5
					M	None	00449	released 10/5
					M	None		died in net
10/6	High 1:58 pm	10:00 am	11:00 am	1	F	Ad. clip	00445	released 10/6
			1:30 pm	1	M	None	00446	released 10/6
10/7	High 2:30 pm	9:30 am	12:35 pm	1	M	None	00444	released 10/7
			3:00 pm	3	M	None	00441	released 10/7
					F	Ad. clip	00442	released 10/7
					M	None	00443	released 10/7
10/8	High 2:58 pm	9:00 am	9:15 am	1	M	Ad. clip	00440	released 10/8
			11:15 am	6	F	Ad. clip	00501	released 10/8
					F	Ad. clip	00502	released 10/8
					F	Ad. clip	00503	released 10/8
					M	None	00504	released 10/8
					M	None	00505	released 10/8
					M	Ad. clip	00506	released 10/8
			3:20 pm	1	F	None		died in net
10/9	Low 9:15 am	10:30 am	11:20 am	1	M	Ad. clip	0092	ripening study*
			12:00 pm	1	F	Ad. clip	0093	ripening study*
			1:40 pm	1	M	None	00509	released 10/9
10/11	Low	9:10 am	9:15 am	1	F	Ad. clip	0094	ripening study*

Table 15: (Con't) 1976 Fish Creek gill net catch summary

Date	Tide	Set Time	Time Caught	#Fish	Sex	Markings	Floy Tag#	Disposition
	10:15 am		4:00 pm	8	F	Ad. clip	00521	released 10/12
					F	None	00522	released 10/12
	High				F	Ad. clip	0095	ripening study*
	4:22 am				F	Ad. clip	0096	ripening study*
					M	Ad. clip	0097	ripening study*
					F	Ad. clip	0098	ripening study*
					F	Ad. clip	0099/00569	ripening study*
					F	Ad. clip	0100	ripening study*
10/12	Low	11:30 am	12:50 pm	2	F	Ad. clip	00517	released 10/12
	10:49 am				F	Ad. clip	00447	ripening study*
			2:30 am	1	F	None	00515	released 10/12
10/13	Low	9:25 am	9:30 am	1	F	Ad. clip	00514	released 10/13
	11:23 am		10:30 am	1	F	Ad. clip	00512	released 10/13
10/14	High	9:10 am	9:50 am	2	F	Ad. clip	00510	released 10/14
	6:27 am				F	Ad. clip	00511	released 10/14
			12:15 pm	1 king	F	Ad. clip	00526	released 10/14
						1/2 dorsal		
			12:40 pm	1	F	Ad. clip	00527	released 10/14
10/15	High	9:30 am	9:50 am	1	F	Ad. clip	00529	released 10/15
	7:23 am							

G



Weight (g)

Week

Weight (g)	Week
4.4	1
18.0	4
18.9	8
17.1	12

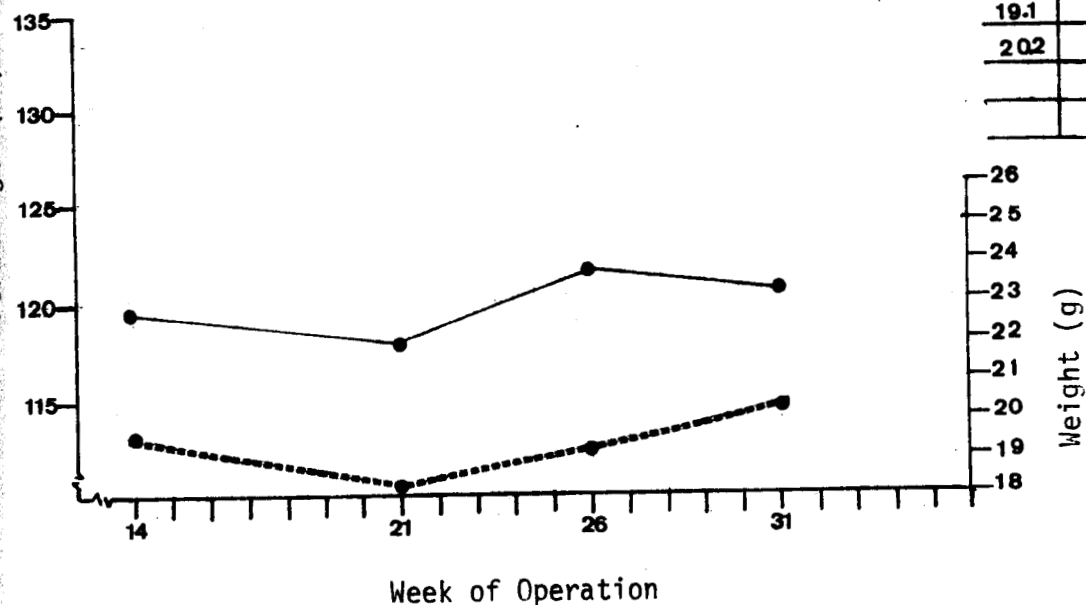
\*Not Taken

Figure 5: (con't) Coho salmon, Fish Creek 1976-77, average fork length and average weight - weeks 1 through 12

Pen # 1

— length  
- - - - - weight

weight g	week	length mm
19.6	14	119.5
18.1	21	118.
19.1	26	121.6
20.2	31	120.5



Pen # 2

weight g	week	length mm
19.6	14	117.9
18.0	21	118.1
19.5	26	122.3
21.5	31	125.4

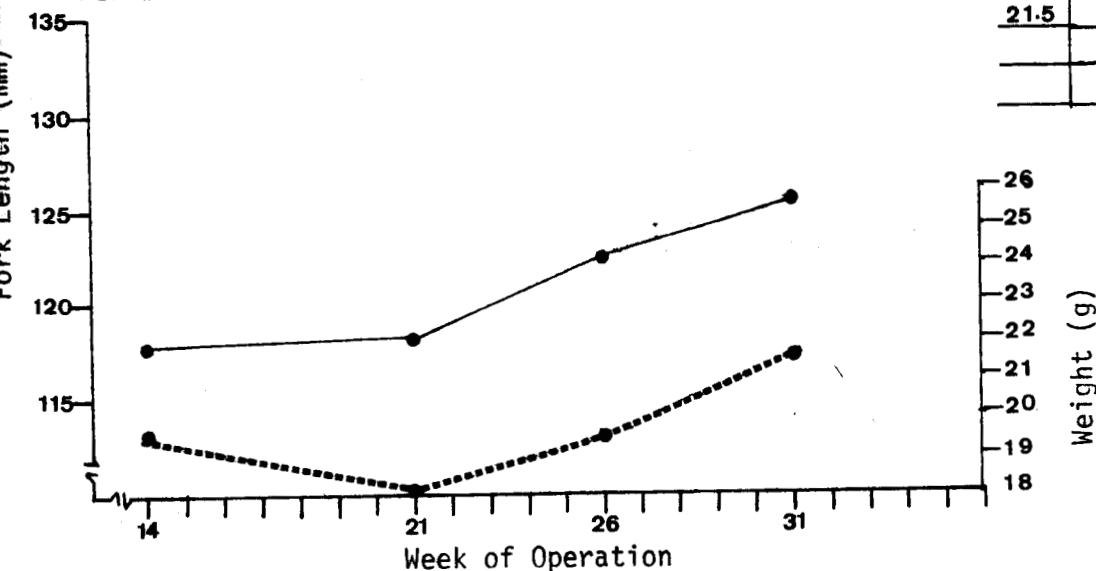


Figure 6: Coho salmon, Fish Creek 1976-77, average fork length and average weight - weeks 14-36

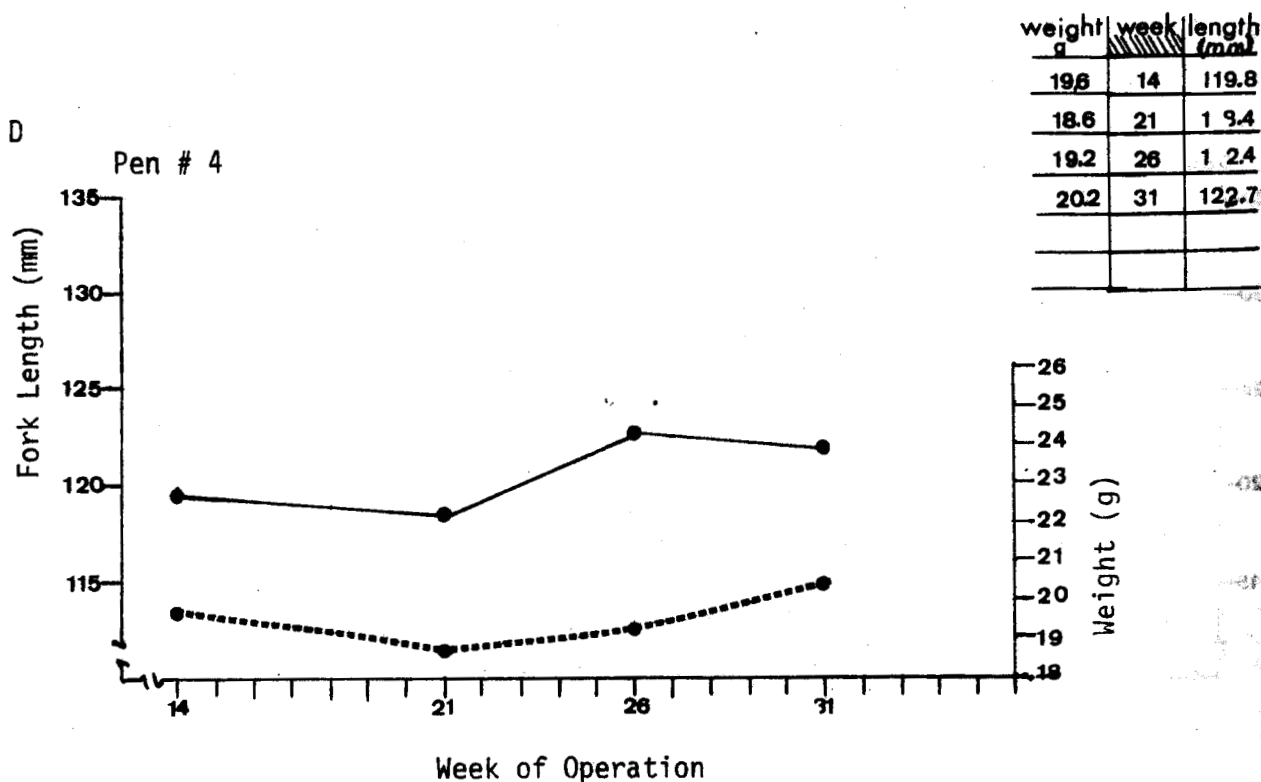
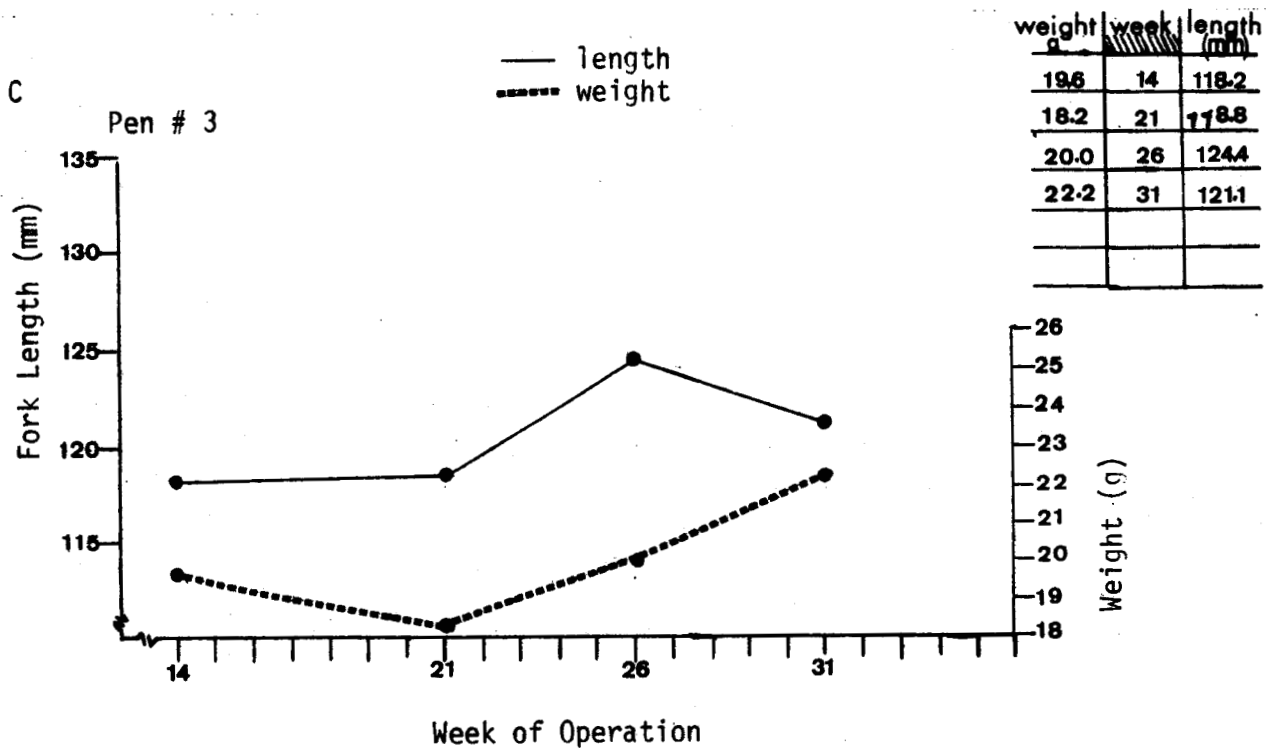
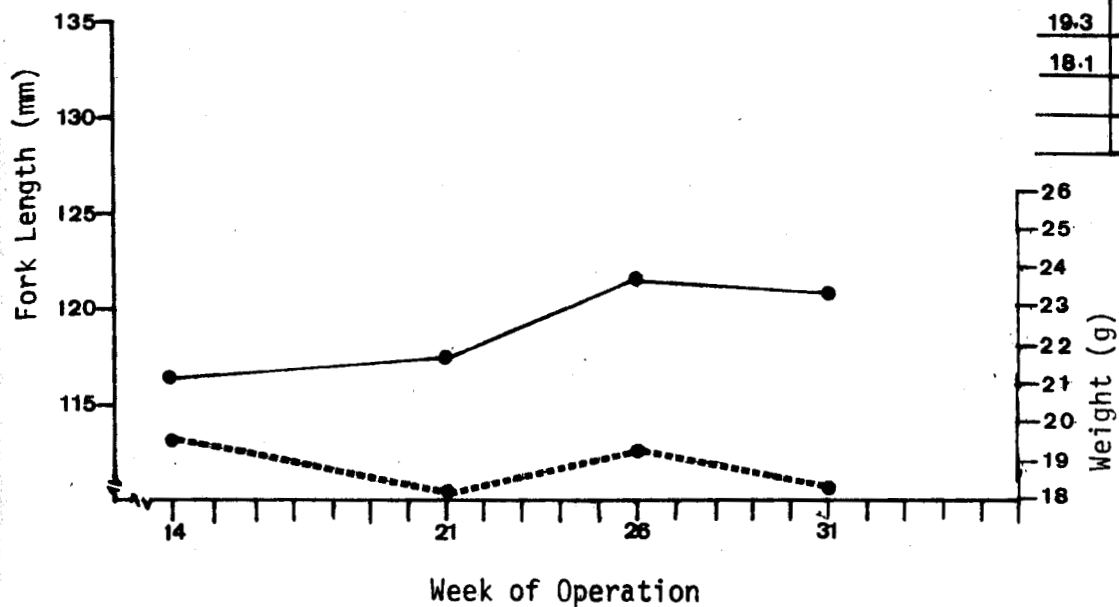


Figure 6: (con't) Coho salmon, Fish Creek 1976-77, average fork length and average weight - weeks 14-36

E

Pen # 5

— length  
 ..... weight



F

Pen # 7

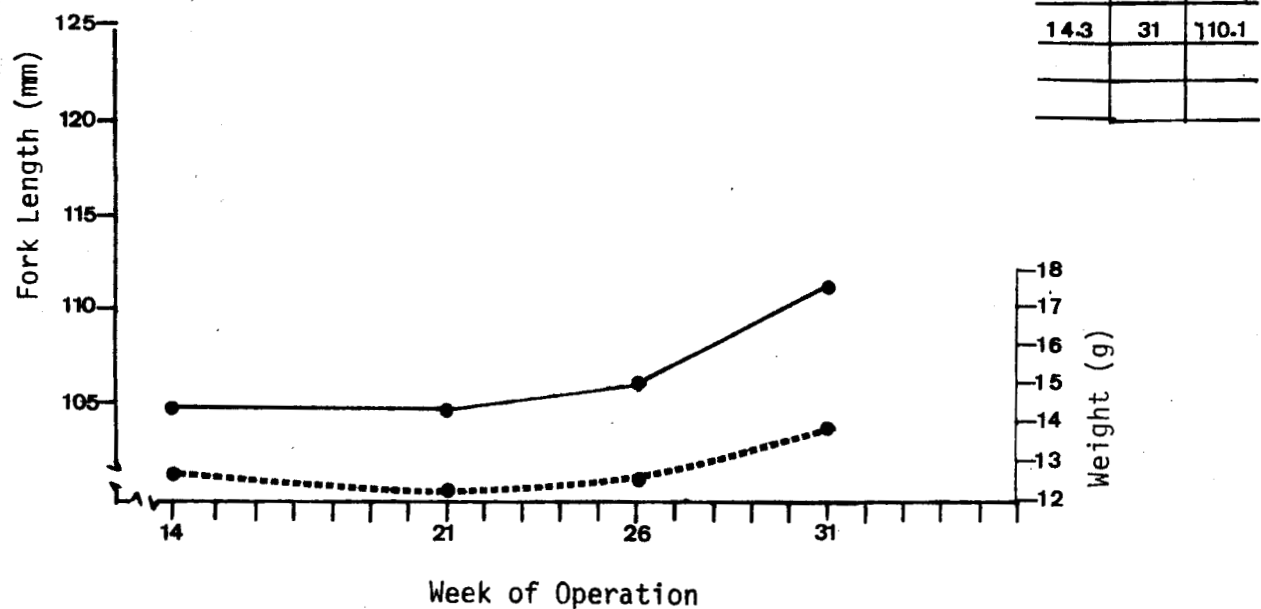
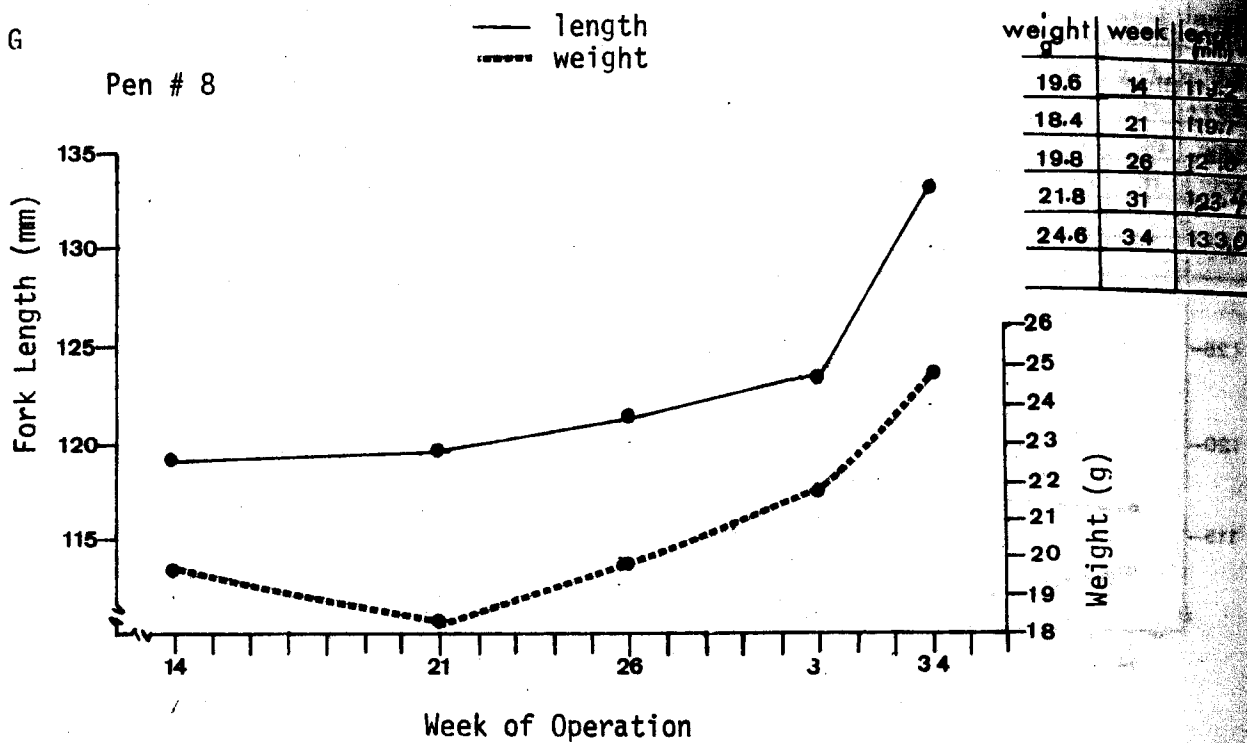


Figure 6: (con't) Coho salmon, Fish Creek 1976-77, average fork length and average weight - weeks 14-36

G

Pen # 8



H

Pen # 9

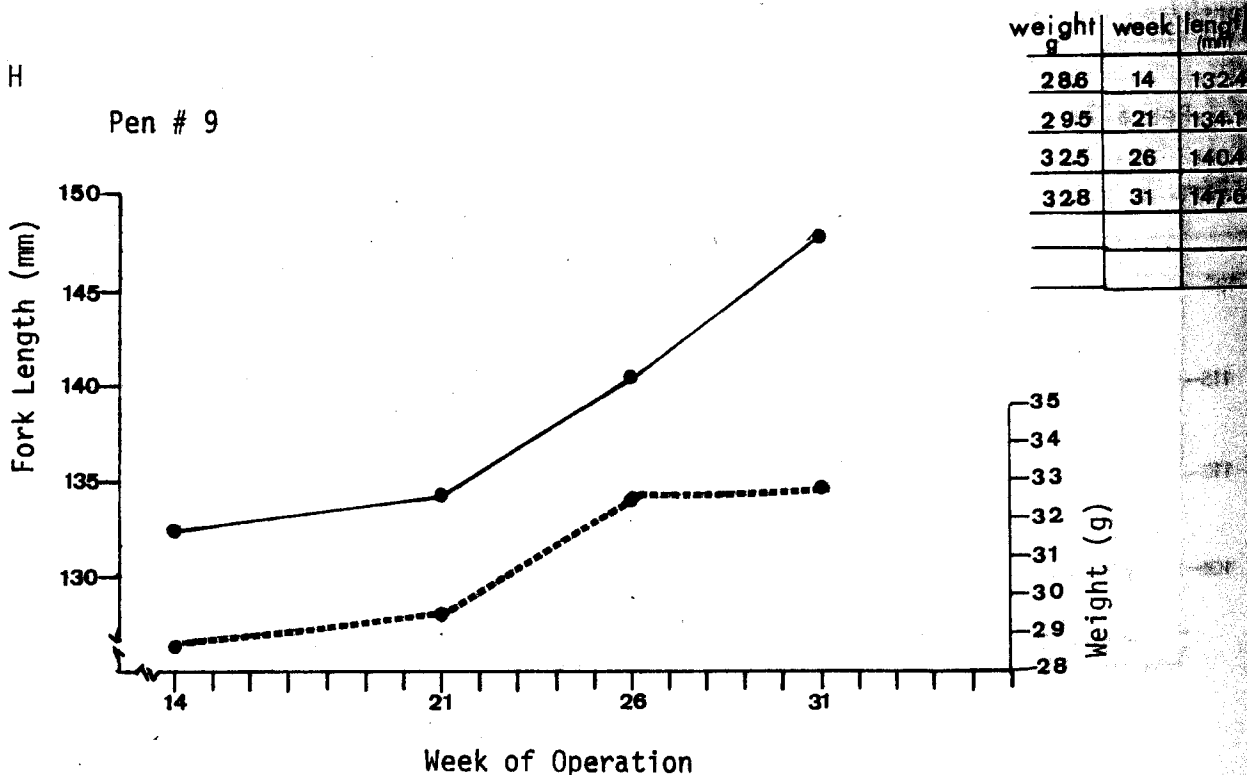


Figure 6: (con't) Coho salmon, Fish Creek 1976-77, average fork length and average weight - weeks 14-36



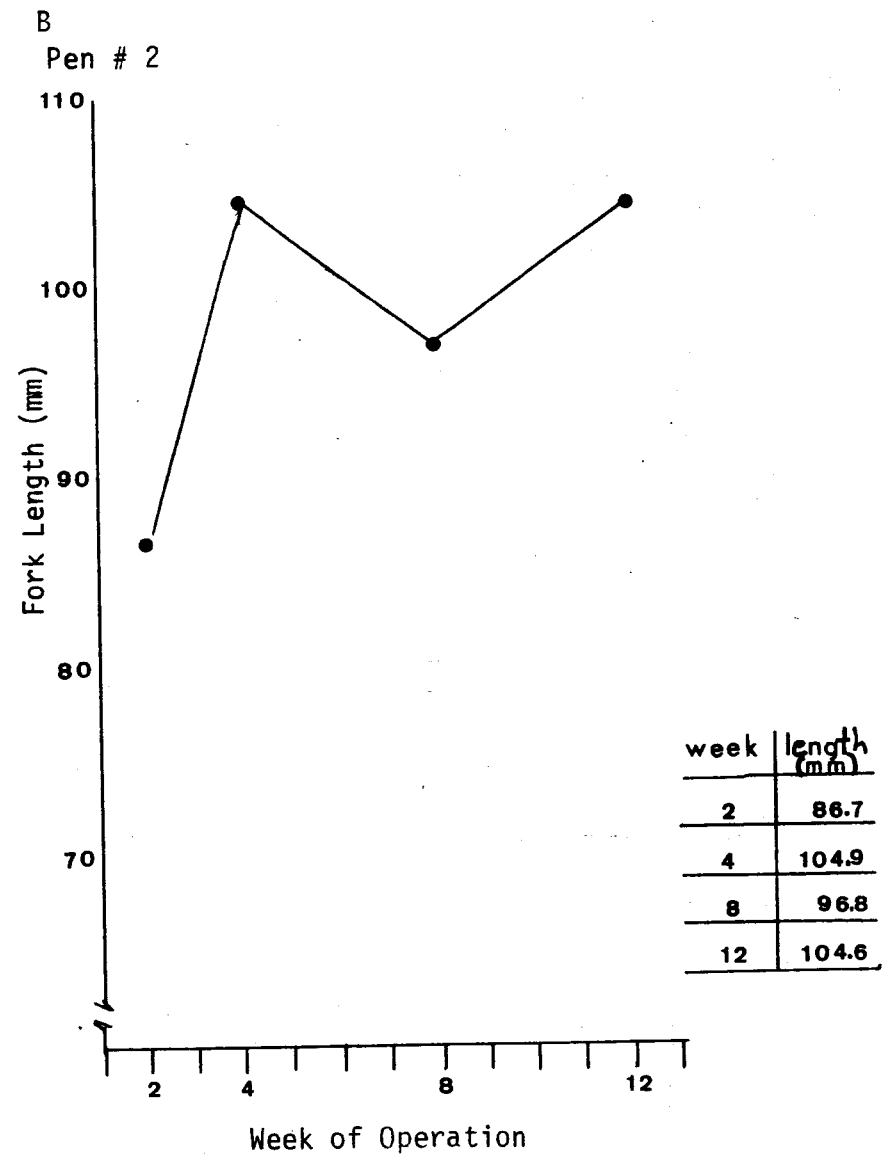
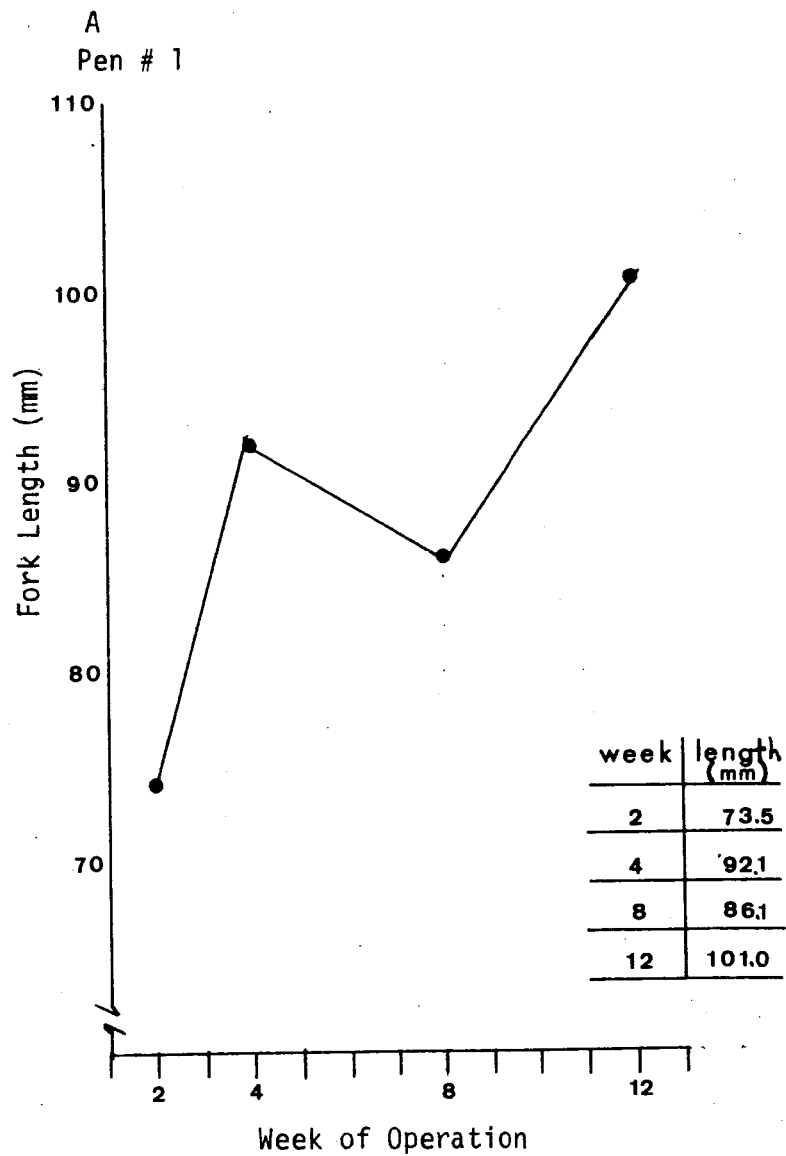


Figure 7: Coho mortalities fork length before biomassing

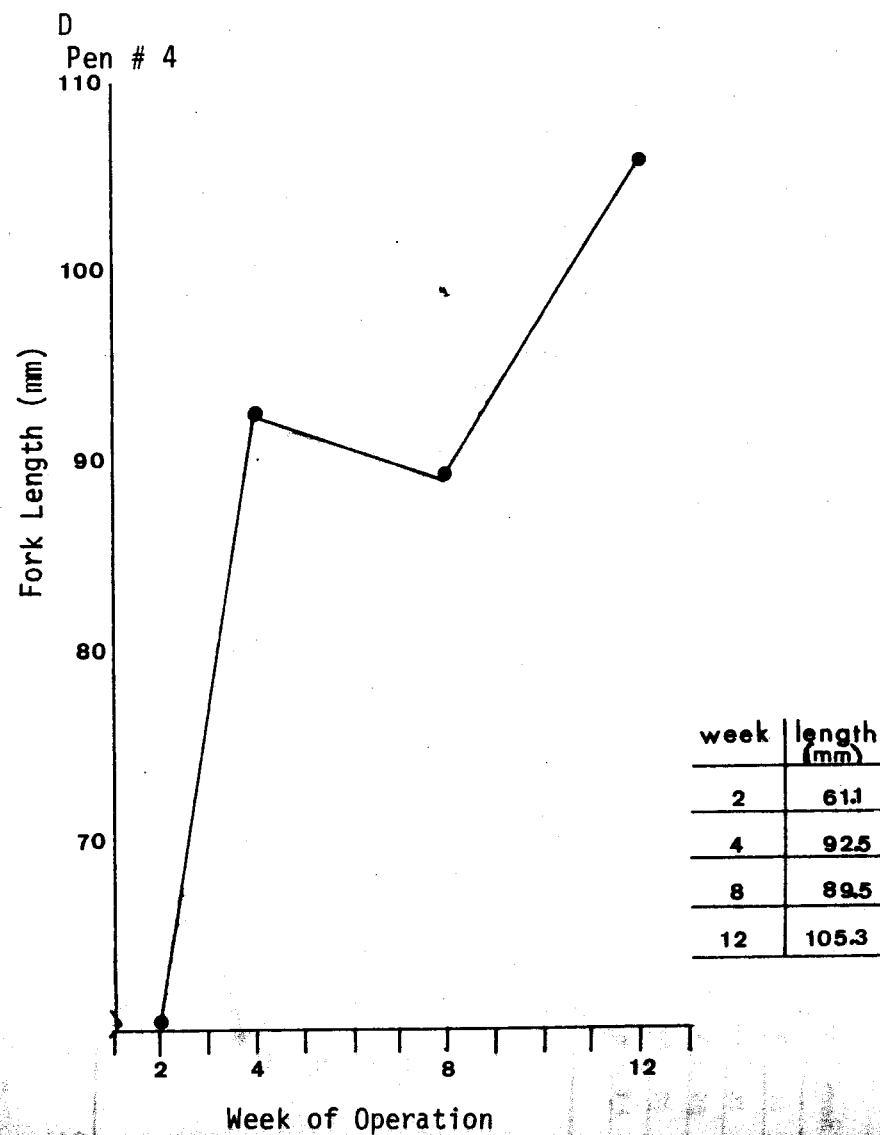
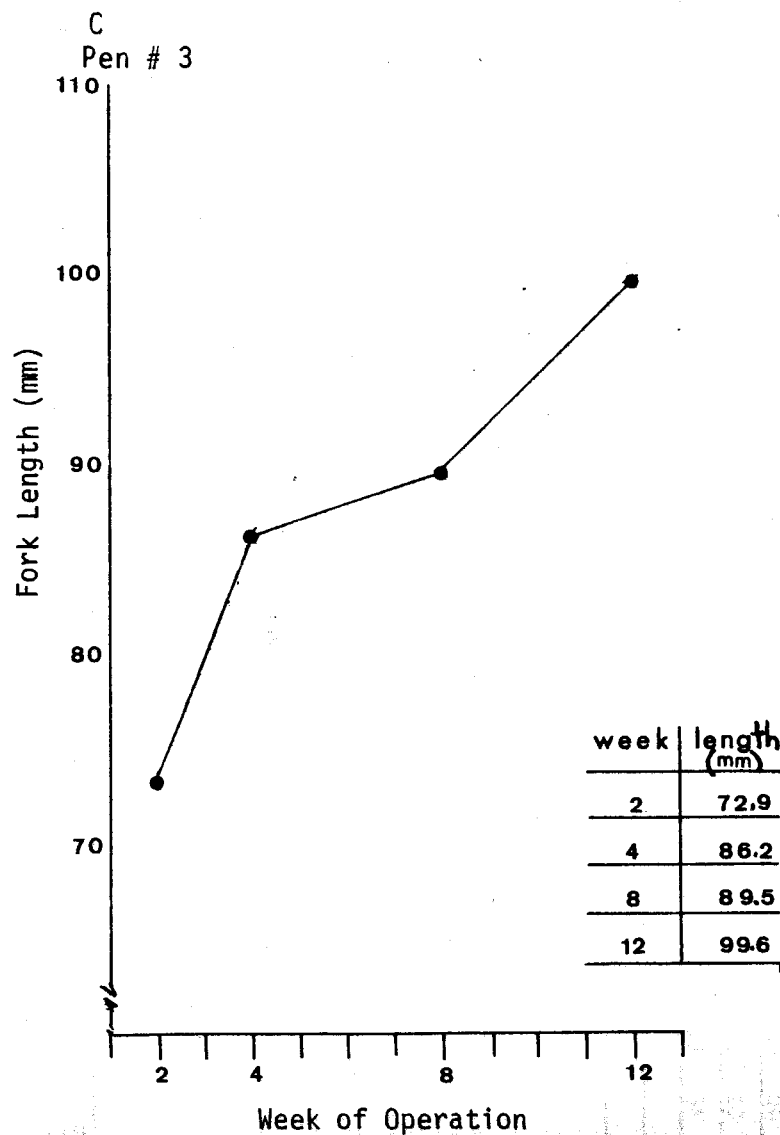


Figure 7: (con't) Coho mortalities fork length before biomassing

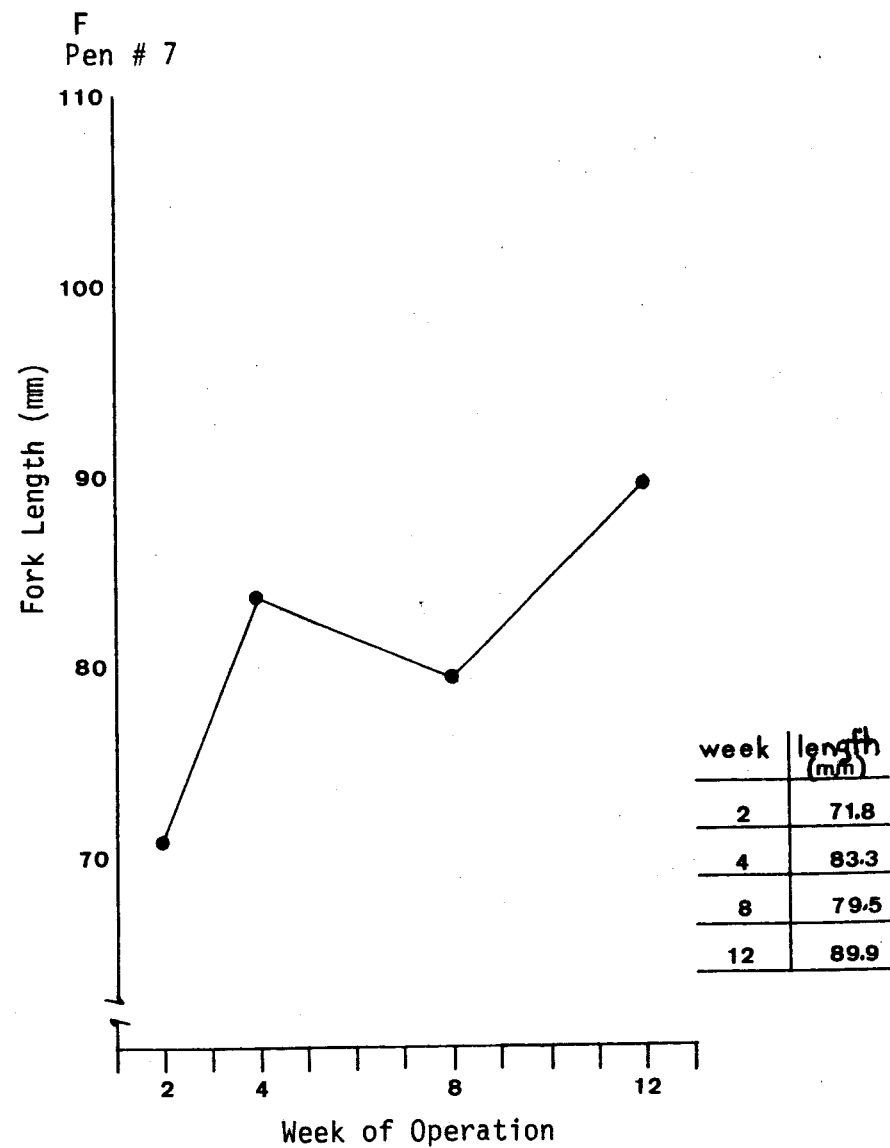
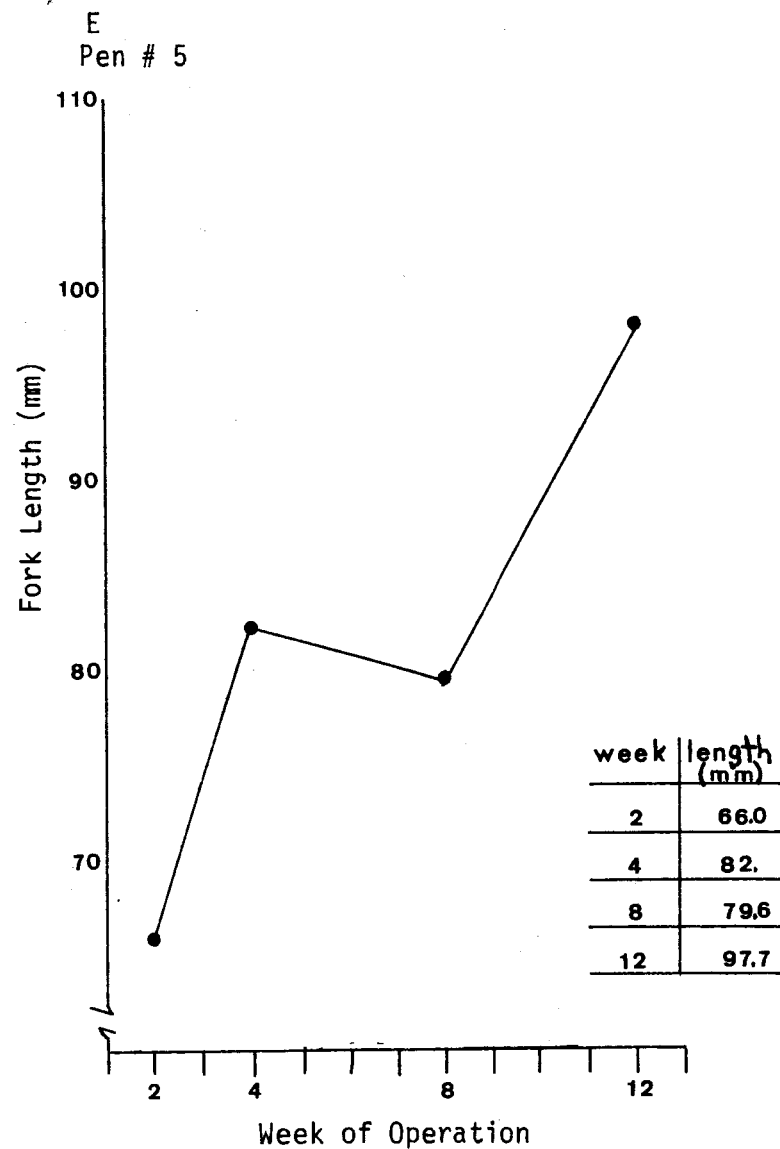
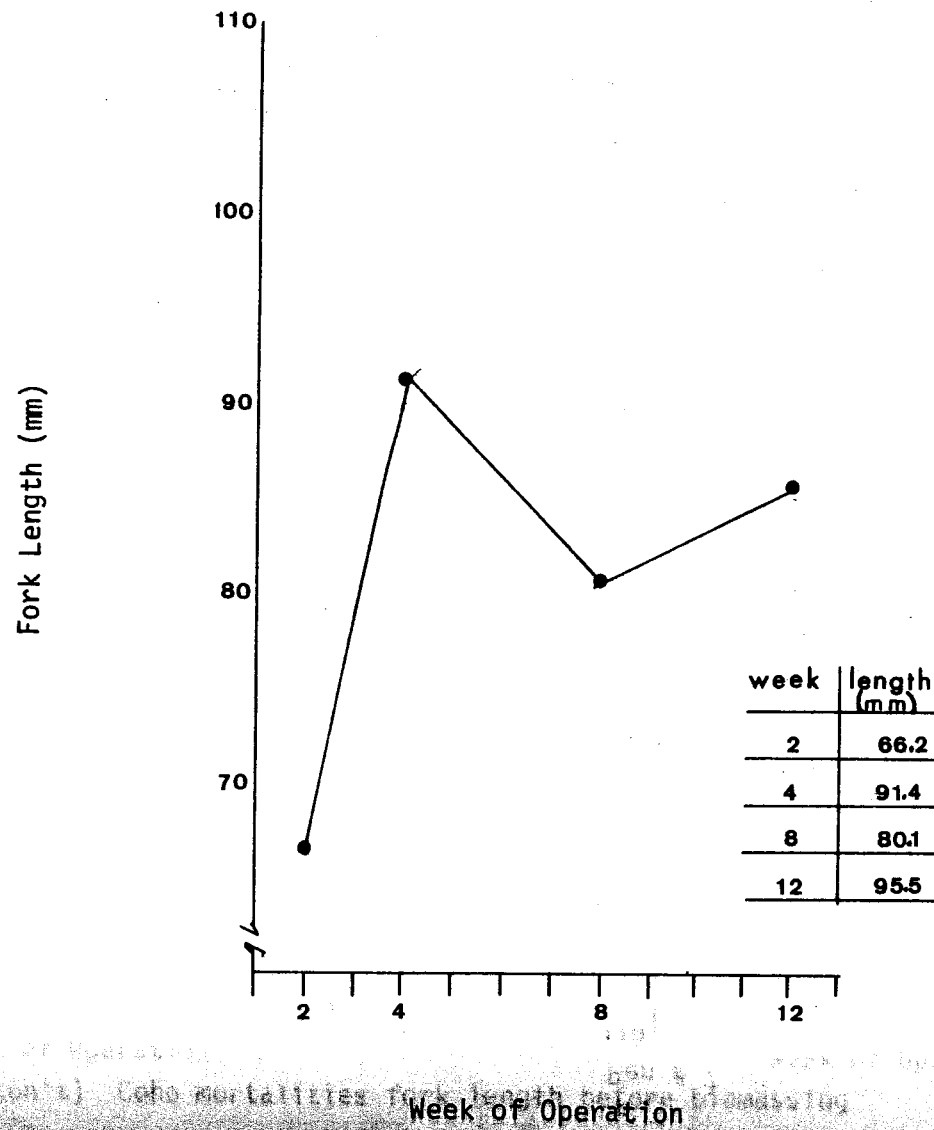


Figure 7: (con't) Coho mortalities fork length before biomassing

G  
Pen # 8



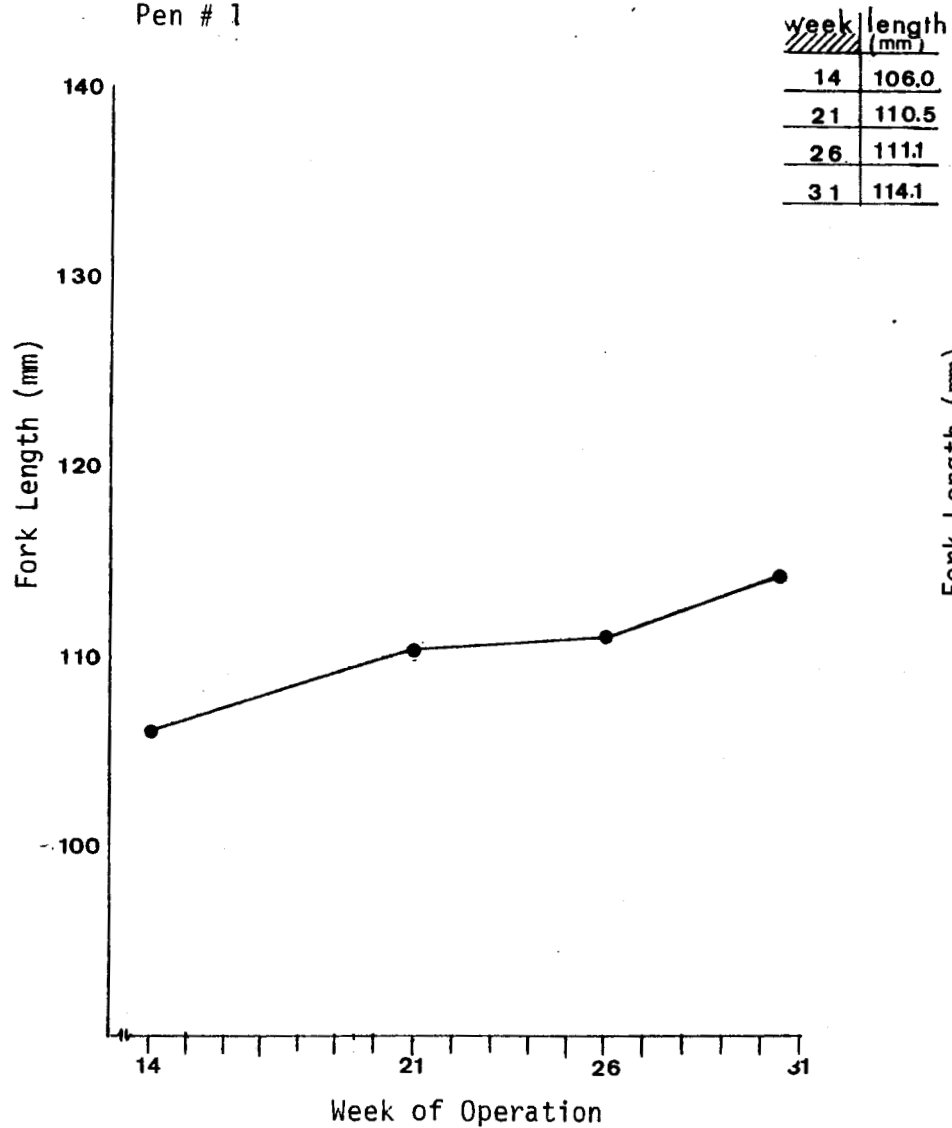
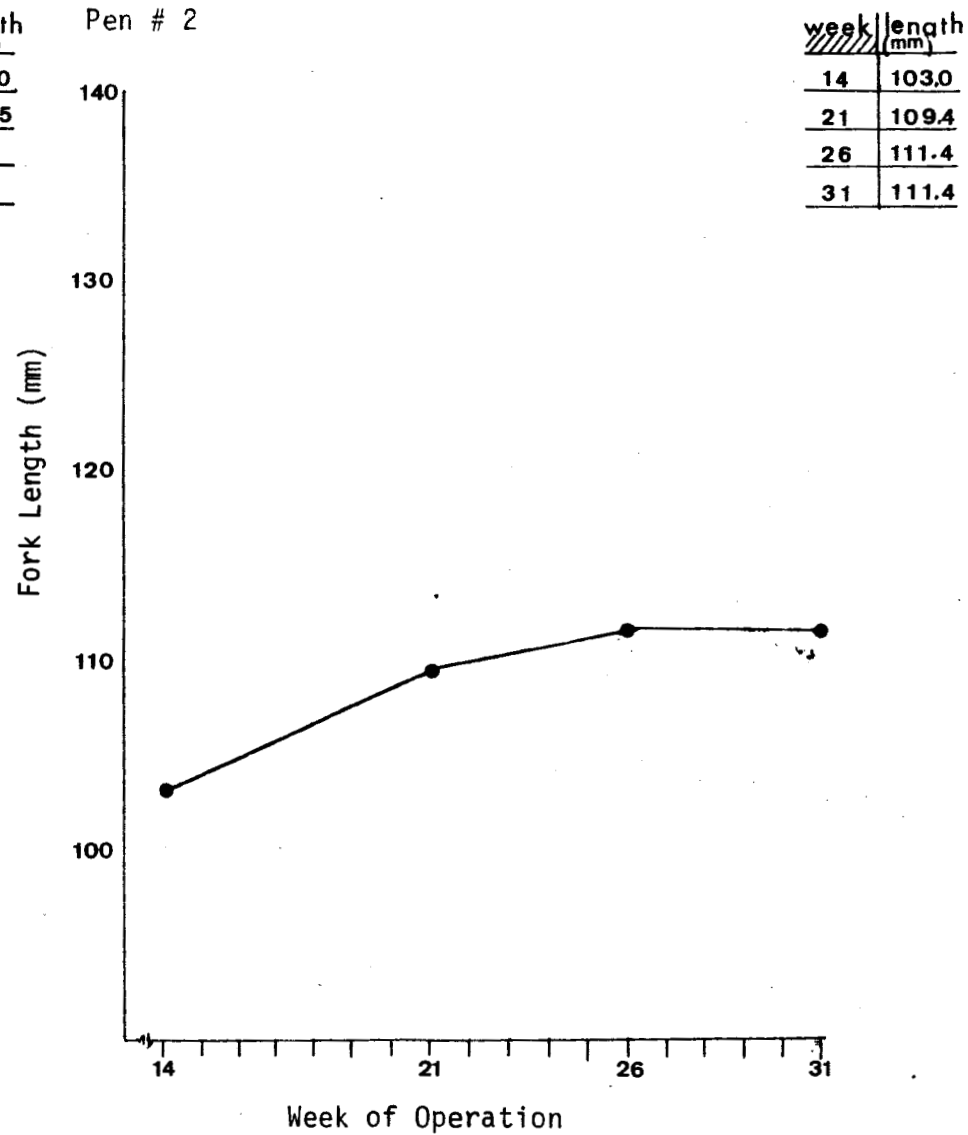
A  
Pen # 1B  
Pen # 2

Figure 8: Coho mortalities, Fish Creek 1976-77, after biomassing

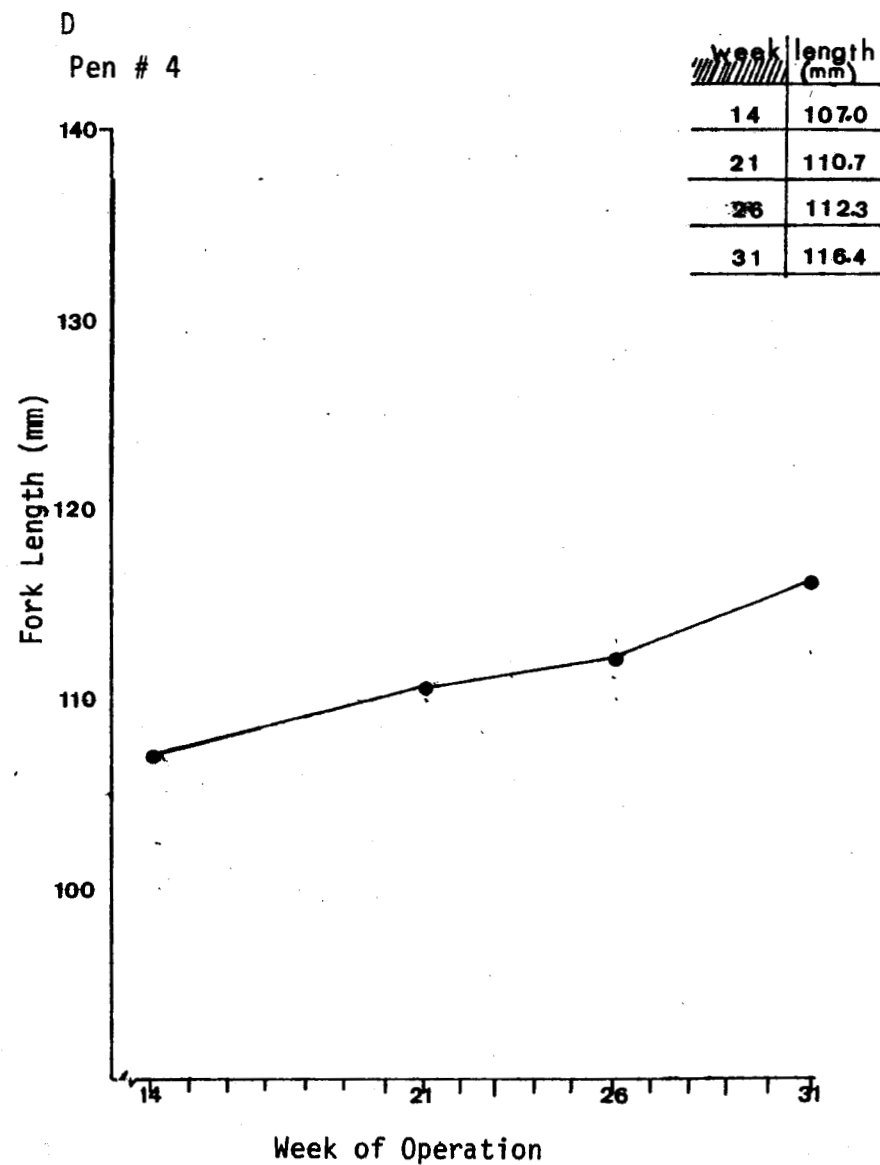
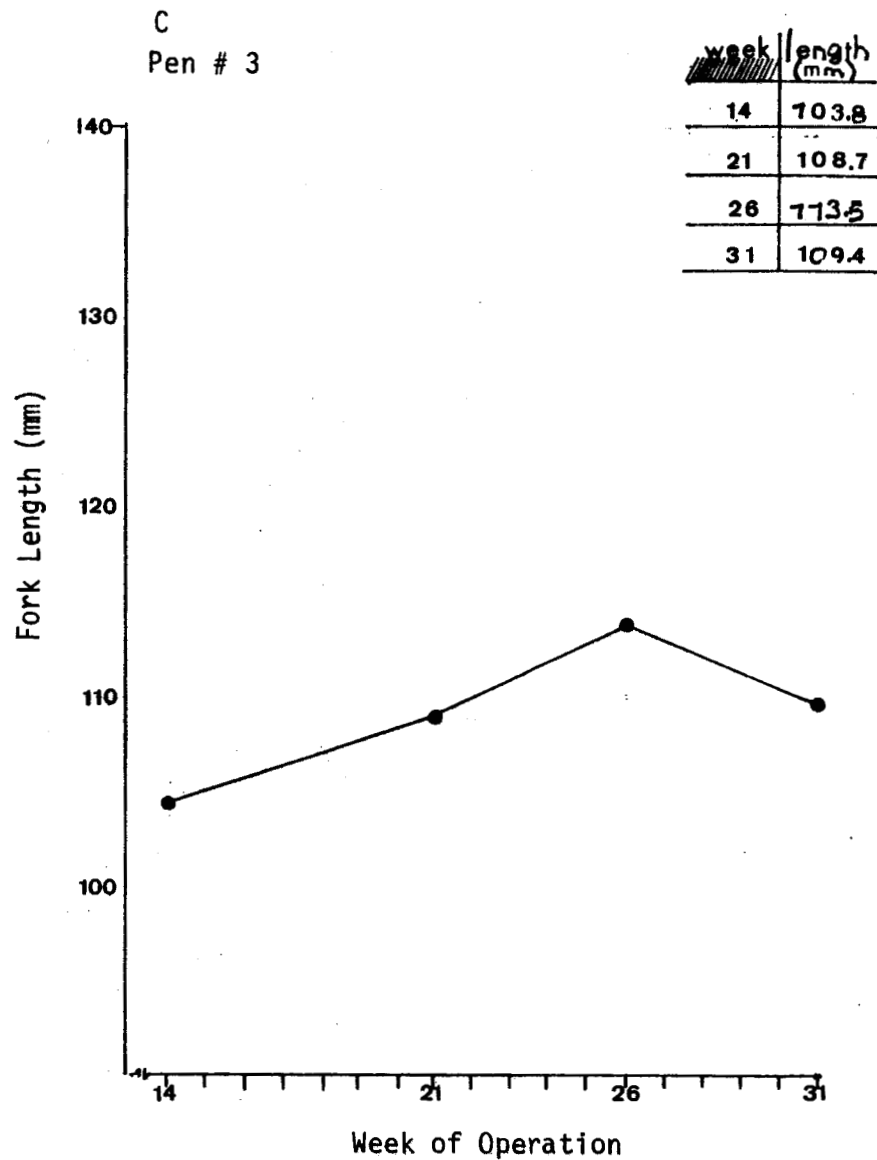
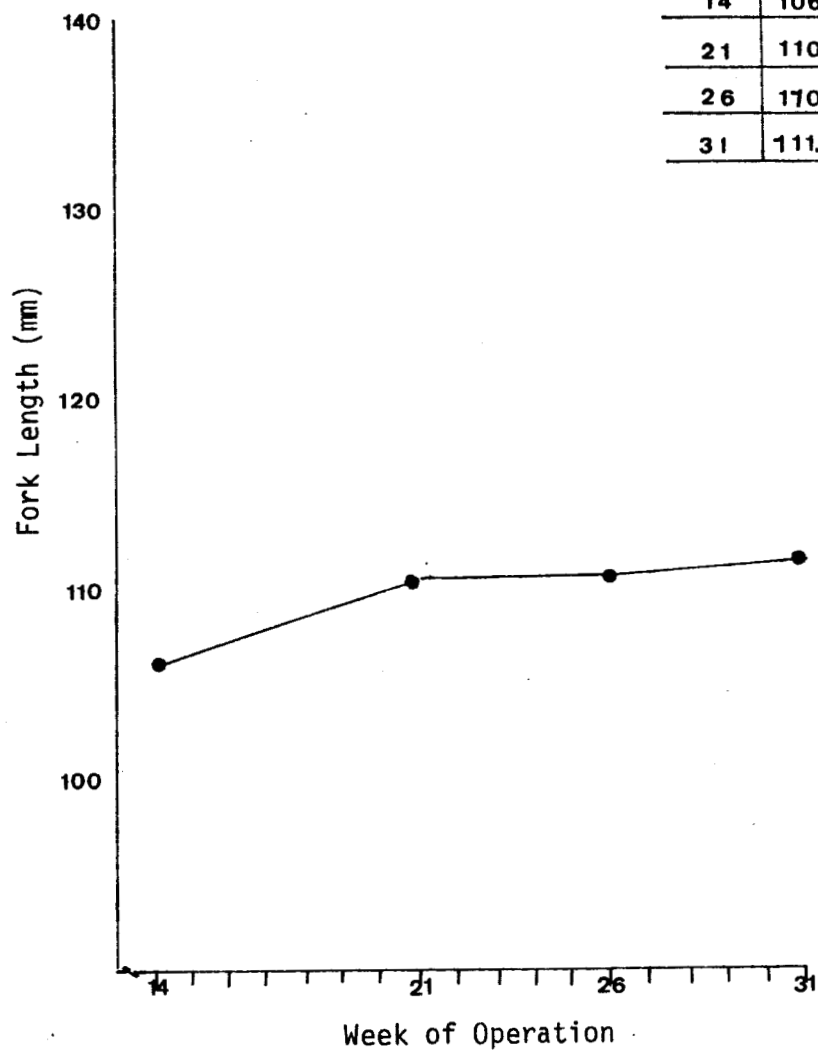


Figure 8: (con't) Coho mortalities, Fish Creek, 1976-77, after biomassing

E  
Pen # 5



F  
Pen # 7

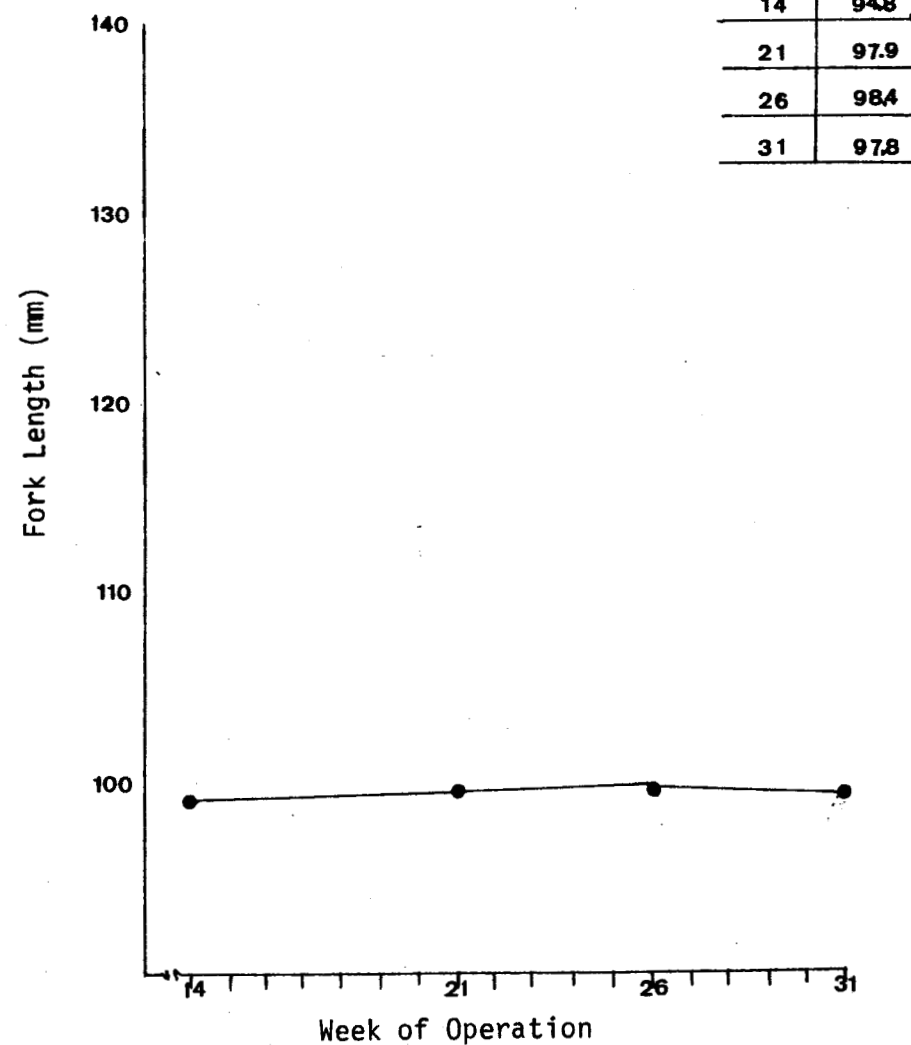


Figure 8: (con't) Coho mortalities, Fish Creek 1976-77, after biomassing

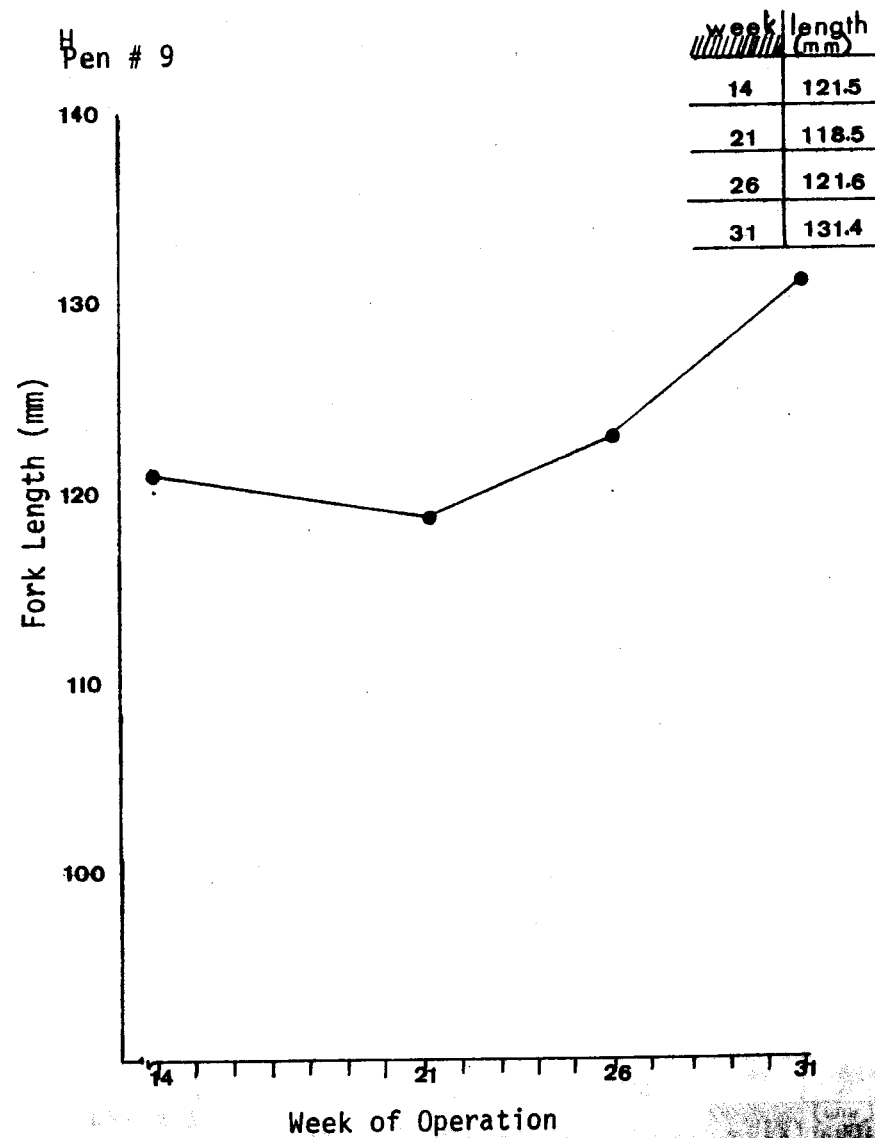
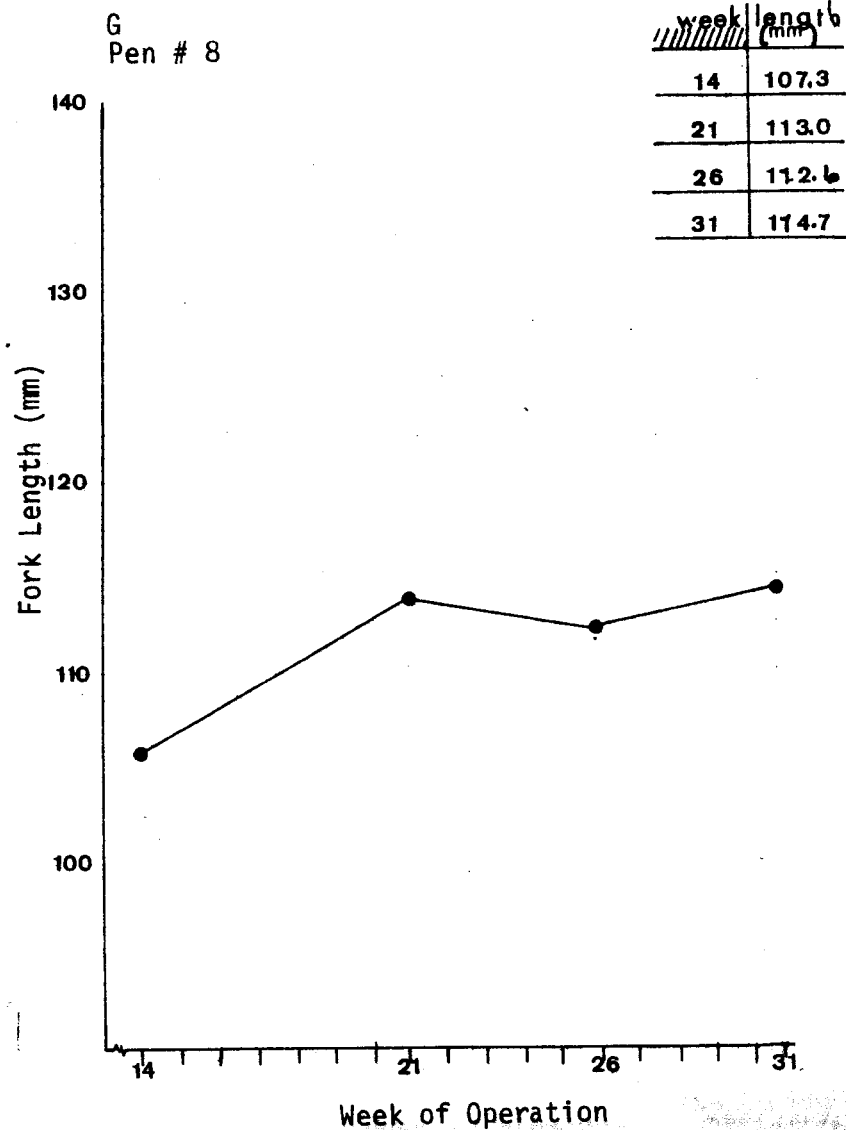


Figure 8: (con't) Coho mortalities, Fish Creek 1976-77, after biomassing



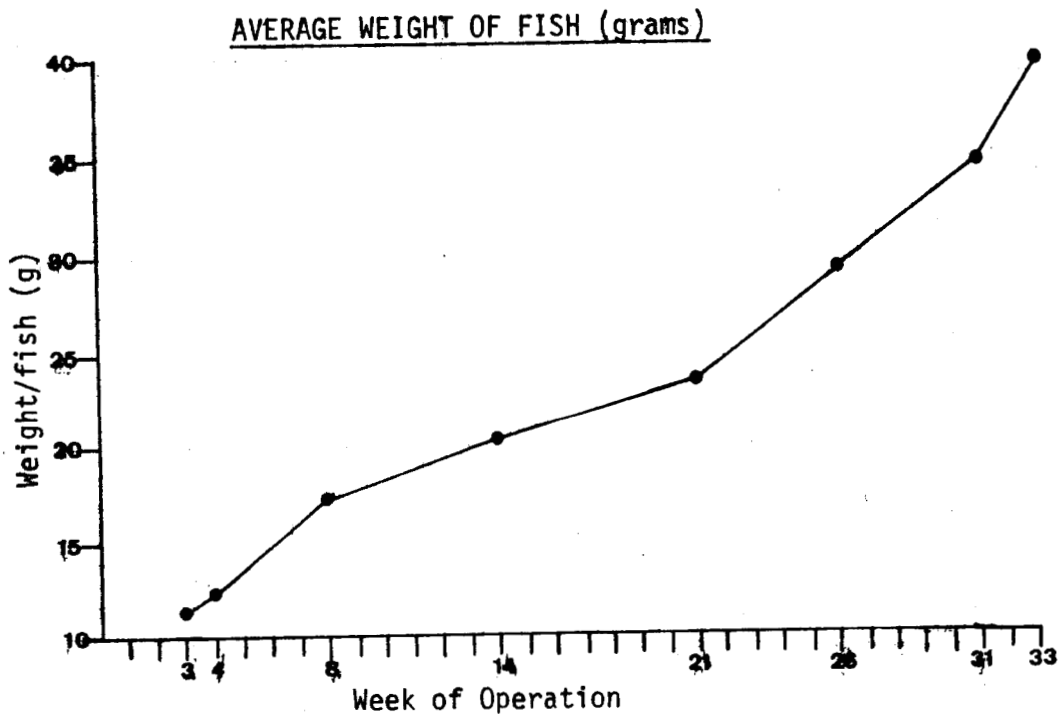
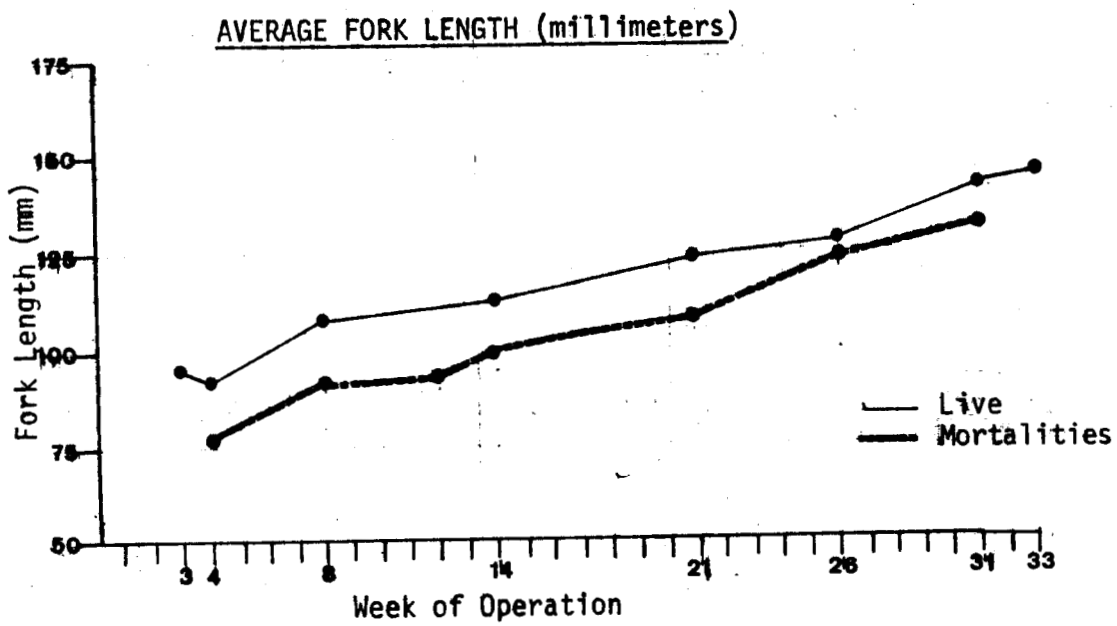


Figure 9: Rainbow trout average fork length and average weight

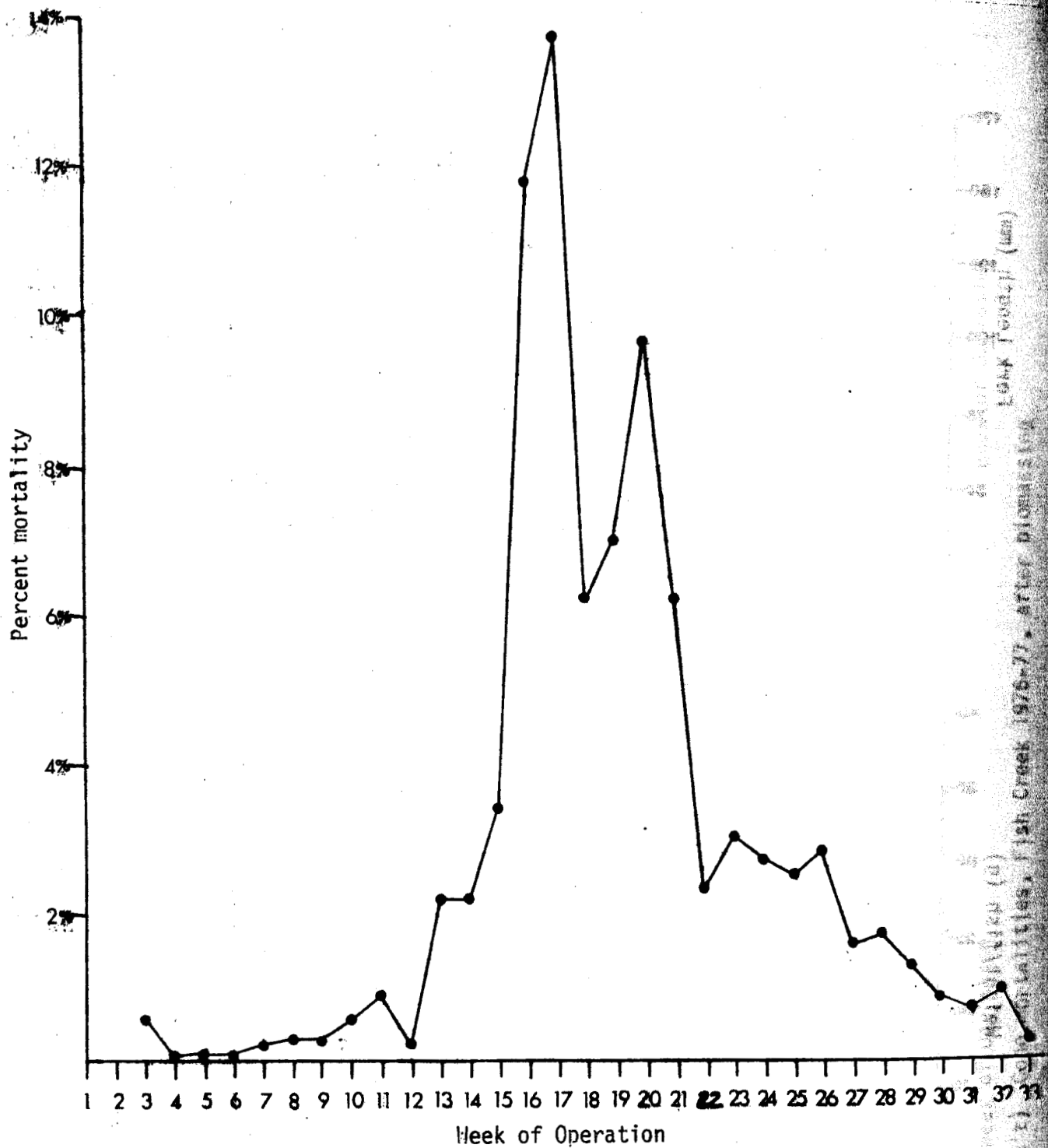


Figure 10: Rainbow trout weekly percent mortality

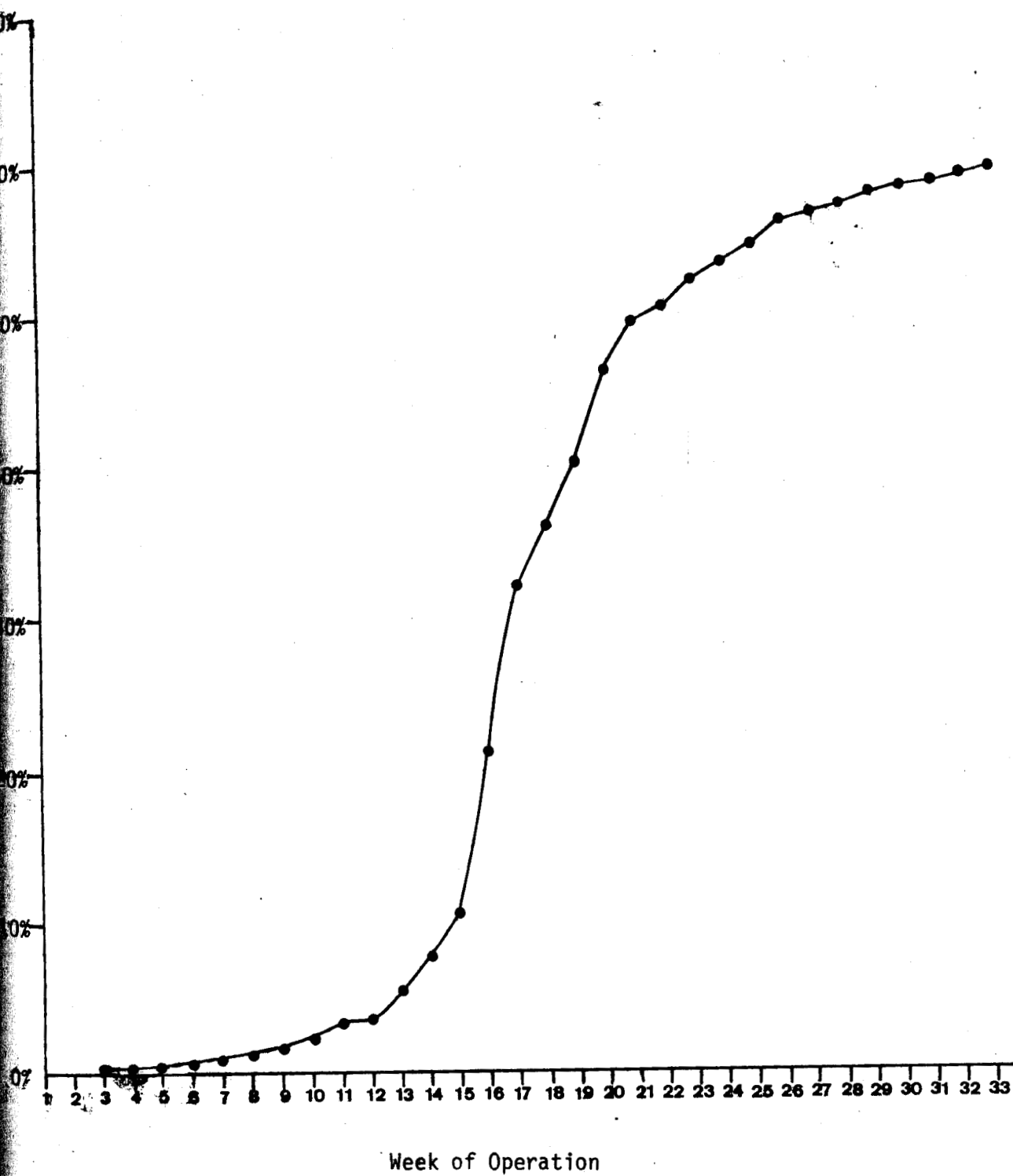


Figure 11: Rainbow trout cumulative percent mortality

Table 7: Data summary-Fish Creek 1976-77 temperature (°C), salinity (ppt), dissolved oxygen (ppm)

Week of Operation	Average Weekly Temperature				Average Weekly Salinity				Dissolved Oxygen			
	Surface	1 mm	3 mm	Range	Surface	1 mm	3 mm	Range	Surface	1 mm	3 mm	Range
1	8.3											
2	8.4						21.0					
3	7.8					17.6	18.9					
4		8.0	8.6	7.5-9.0		16.3	18.9	14.0-20				
5		7.6	8.1	6.9-9.4		18.8	19.3	16.4-22				
6		7.3	7.8	6.9-8.5		19.1	19.9	16.5-22.3				
7		7.4	7.8	7.0-8.5		24.0	24.9	20.0-28.5				
8		6.8	7.2	6.3-7.8		23.5	23.8	18.5-25.0				
9		6.4	6.3	5.9-7.9		20.0	21.1	16.5-22.5				
10		6.3	6.6	5.1-7.2		21.8	22.4	21.5-23.5				
11		5.7	5.8	4.9-6.3		22.0	22.2	21.5-22.7				
12		5.9	6.3	4.9-7.8		21.2	21.7	19.0-22.4				
13		4.7	5.6	2.5-7.0		21.3	21.7	19.9-23.0				
14		4.7	5.2	4.1-6.1		22.5	22.2	20.1-23.5				
15	4.1	4.5	5.3	2.3-5.9	22.1	22.7	22.9	20.3-24.0				
16	4.4	4.9	5.3	3.4-6.2	24.0	24.3	24.2	22.9-25.4				
17	4.3	4.7	5.3	3.3-6.0	25.2	25.4	25.3	23.8-26.2				
18	3.4	3.8	4.4	2.8-5.2	24.9	25.4	25.4	23.4-26.1				
19	3.6	3.9	4.3	2.9-6.0	25.5	26.0	26.0	23.9-26.8				
20	3.8	3.9	4.0	2.9-5.0	26.6	27.9	28.0	24.2-29.5				
21	4.6	4.8	5.2	3.3-6.0	24.5	26.9	27.7	18.1-28.6				
22	4.4	4.7	5.1	3.3-5.9	25.6	27.4	28.0	18.9-28.5				
23	4.7	5.0	5.3	4.0-6.2	27.3	28.1	28.1	19.3-29.0				
24	4.7	4.9	5.2	3.9-5.8	27.1	28.0	28.1	21.2-28.9	9.6	9.2	8.9	8.2-10.4
25	4.6	4.8	5.0	4.0-5.6	27.8	28.0	28.0	27.1-28.8	10.0	9.8	9.7	9.3-10.4
26	4.6	4.7	4.9	4.0-5.4	27.4	27.8	28.1	22.0-28.9	9.4	9.4	9.4	8.5-11.2
27	4.3	4.7	4.9	3.4-5.1	26.6	27.3	27.7	25.1-28.2	9.8	9.8	9.7	9.1-10.6

Table 7: (Con't) Data summary-Fish Creek 1976-77 temperature (°C), salinity (PPT), dissolved oxygen (PPM)

Week of Operation	Average Weekly Temperature				Average Weekly Salinity				Dissolved Oxygen			
	Surface	1 mm	3 mm	Range	Surface	1 mm	3 mm	Range	Surface	1 mm	3 mm	Range
28	4.6	4.8	5.0	3.9-5.4	26.4	27.0	27.3	22.1-28.1	9.3	9.3	9.5	7.9-10.2
29	4.8	4.9	4.9	4.2-5.2	25.6	26.2	26.5	23.2-27.0	10.0	10.0	10.0	9.4-10.7
30	5.2	5.1	5.1	4.8-6.0	24.5	25.8	26.1	20.9-26.7	10.6	10.5	10.4	9.6-11.4
31	4.9	5.0	5.0	4.5-5.1	24.3	24.4	24.8	20.9-26.0	10.8	10.8	10.7	9.9-11.3
32	5.8	5.7	5.6	4.9-8.0	24.1	24.5	24.9	21.2-25.9	10.7	10.9	11.1	10.2-12.3
33	*	*	*	6.0-9.3	*	*	*	21.0-26.0	**	**	**	**
34	7.2	7.2	7.1	6.2-8.2	19.5	20.4	22.0	15.6-23.2	**	**	**	**
35	8.2	8.0	7.3	6.4-9.3	20.1	21.6	23.0	16.9-23.9	**	**	**	**

\* Data Lost

\*\* Broken Probe-not taken

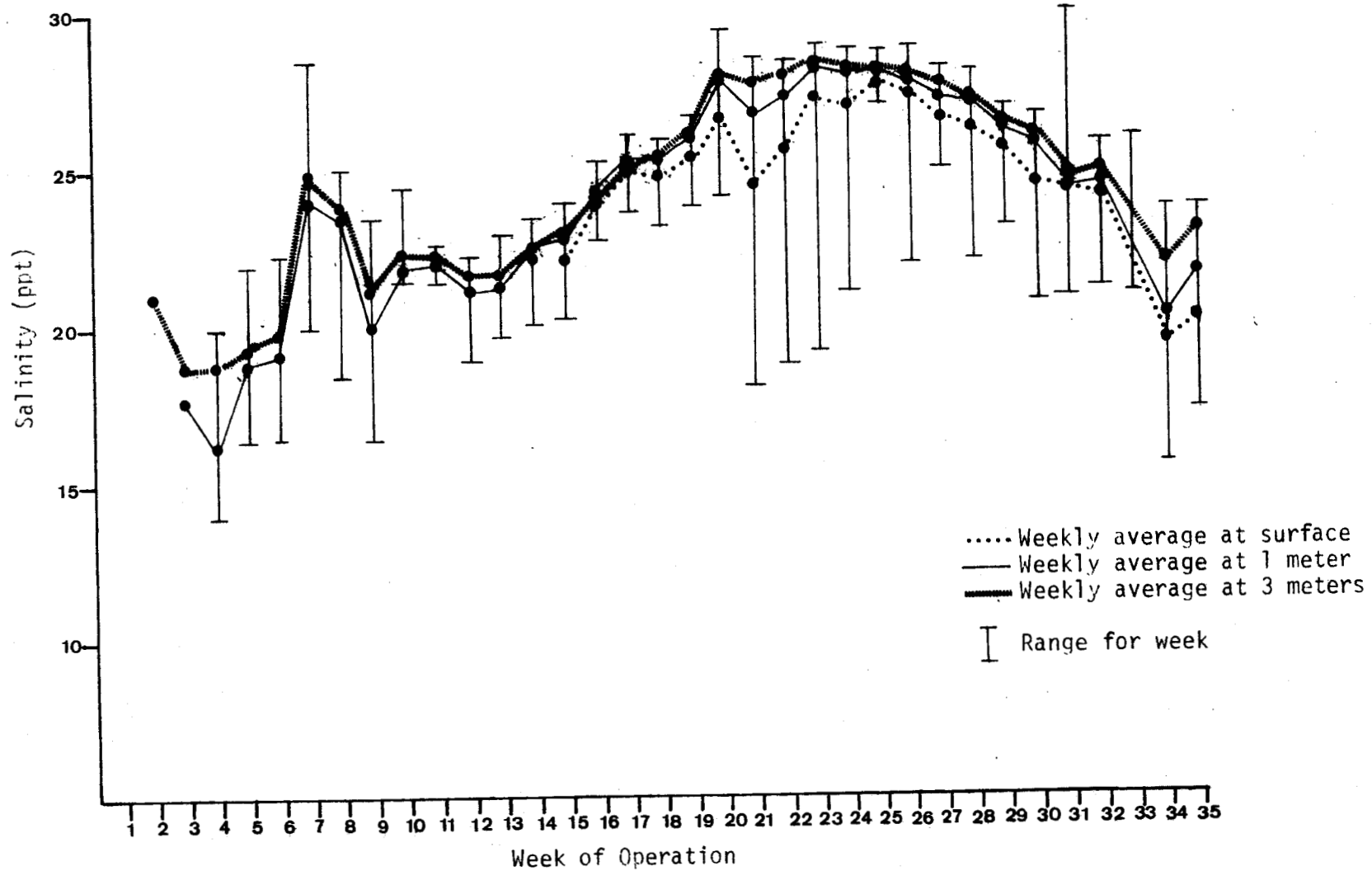


Figure 12: Fish Creek data, 1976-77 - Salinity (ppt)

## Grading

All cohos at the facility were graded with a Nielson Grader during the 12th week of operation (Figure 13). Information gathered from length-weight samples of November 4, 1976 was used to determine the number of groups and size of fish in the groups to be graded. The length frequency exhibited in Table 10 and Figure 14 show 11.7% of the fish sampled were from 69 to 100 mm in length, 70.2% were from 101 to 125 mm and 18.1% were between 126 and 177mm. Arbitrary cut-off points were determined from lengths of lower frequency in the sample population exhibited in Figure 14. Table 11 and Figure 15 summarize data obtained prior to and after grading.

Discrepancies between the two biomasses (December 1-3 and 8-9) were attributed to (1) escape during grading of an undetermined amount of small fish due to a loose hose connection and (2) documented otter predation. The second biomass is more accurate in consideration of these two factors and better sampling conditions during the second biomassing. Better sampling conditions mean calmer water which enabled greater accuracy in reading spring scales (Figure 13). Survival figures for the coho salmon were adjusted to incorporate the new biomass data.

High coho mortality in January (week #17 of operation) was felt to be stress related due to handling in early and middle December when biomassing and grading were conducted. Experimental grading in order to test this latter point on one pen (pen #2) of fish began on March 26, 1977 (26th week of operation). The mortality rates did not differ significantly from mortality rates in all other pens one to two weeks later (Table 12 and Figure 16; A-H).

Table 15: (Con't) 1976 Fish Creek gill net catch summary

Date	Tide	Set Time	Time Caught	#Fish	Sex	Markings	Floy Tag#	Disposition
10/16	High	9:00 am	11:00 am	1	M	Ad. clip	00516	ripening study*
	8:33 am		2:50 pm	1	F	Ad. clip	00528	released 10/16
10/18	High	8:40 am	8:55 am	1	F	Ad. clip	00551	released 10/18
	10:55 am							
10/19	High	9:30 am	11:40 am	4	F	Ad. clip	00571	ripening study*
	11:43 am				M		00573	ripening study*
					M	None	00572	released 10/19
					M		00575	
			12:45 pm	1	F	Ad. clip	00570	released 10/19
10/22					F	Ad. clip	00552	ripening study*

\*Indicates fish used in ripening study



Table 16: Fish used in the Fish Creek ripening study

Floy Tag No	Code	Sex	Caught	Disposition	Size
0092	4-2-13	M	10/9	spawned 10/29	fork length - 660mm
0093	4-2-12	F	10/9	spawned 10/22	fork length - 630mm
0094	4-2-12	F	10/11	spawned 10/29	fork length - 680mm
0095	4-2-13	F	10/11	spawned 10/22	fork length - 690mm
0096	4-2-12	F	10/11	spawned 10/22	fork length - 660mm
0097	4-2-12	M	10/11	spawned 10/22	fork length - 690mm
0098		F	10/11	released 10/29 (not ripe)	
0099/00569					
	4-2-13	F	10/11	spawned 10/29	fork length - 670mm
0100	4-4-12		10/11	found dead 10/22	fork length - 680mm
		F		wounds on belly	
0447		F	10/12	released 10/29 (not ripe)	
0516	4-2-12	M	10/16	spawned 10/22	fork length - 635mm
0571		F	10/19	escaped 10/21 while changing net	
0573	4-2-12	M	10/19	spawned 10/29	fork length - 610mm
0552	4-2-12	F	10/22	spawned 10/29	fork length - 650mm

Table 17: Survival of 1976 brood from Fish Creek ripening study\*

<u>Egg Take</u>	<u>Heath Tray Number</u>	<u>Number Live Eggs (Eyed)</u>	<u>Dead Eggs</u>	<u>Total Eggs</u>	<u>Survival to Eyed Stage (%)</u>
1	40	8151	533	8684	93.9
2	11	9004	667	9671	93.1

\*Additional information on hatching indicates as a lot 83% survived to the alevin stage after the eyed eggs were seeded in an experimental incubator at Auke Bay. Information contained here received from personal communication.

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Table 18: Summary of 1977 smolt tagging and release at Fish Creek Estuarine Rearing Facility

Brood Stock	Date of Release	Binary Code	Total Kg.	Fish/ Kg.	Mean Fork Length(mm)	Percent Valid Marks	Valid Marked Fish In Release Group	Total Release
1975 Mendenhall Coho	4/20	4-16-4	246.8	43.4	131.1	96.6 <sup>1)</sup>	10,349	10,713
1975 Mendenhall Coho	4/30	none	134.6	49.5	121.1	n/a	0	6,660
1975 Mendenhall Coho	5/09	4-16-51	302.8	25.1	149.2	98.5 <sup>2)</sup>	7,486	7,600
1975 Mendenhall Coho	5/09	none	353.7	35.6	139.8	n/a	0	12,590
1975 Blind Slough Coho	5/16	4-16-17	254.2	42.1	133.2	97.5 <sup>3)</sup>	10,435	10,703
1975 Blind Slough Coho	5/16	none	283.6	39.3	Not Taken	n/a	0	11,144
1975 Blind Slough Coho	5/16	none	271.7	40.3	Not Taken	n/a	0	10,948
1975 Mendenhall Coho	5/20	4-16-5	138.0	44.6	128.4	94.2 <sup>4)</sup>	5,798	6,155
1975 Mendenhall Coho	5/20	4-16-6	260.3	40.9	134.3	97.2 <sup>5)</sup>	10,350	10,648
1975 Mendenhall Coho	5/20	4-16-39	212.4	39.7	137.2	99.4 <sup>6)</sup>	8,381	8,432
1976 Ship Creek King	6/10	4-17-5	269.6	77.2	103.0	91.7 <sup>7)</sup>	19,086	20,814
1976 Ship Creek King	6/17	4-17-7	296.0	71.9	105.4	97.2 <sup>8)</sup>	20,688	21,284
1976 Ship Creek King	6/24	4-17-6	310.7	68.9	108.2	97.6 <sup>9)</sup>	20,893	21,407
1976 Ship Creek King	6/29	4-16-41	381.5	65.8	111.9	98.2 <sup>10)</sup>	24,650	25,102
1975 Blind Slough Coho	7/20	4-16-52	840.1	21.0	163.1	97.9 <sup>11)</sup>	17,266	17,642
1975 Blind Slough Coho	7/20	4-16-53	280.0	21.0	163.1	97.9 <sup>11)</sup>	5,755	5,880

1) tag retention 4/7-20(141/146)

2) tag retention 4/26-5/9(194/197)

3) tag retention 5/13-16(156/160)

4) tag retention 4/28-5/20(130/138)

5) tag retention 4/22-5/20(165/166)

7) tag retention 6/9-10(233/254)

8) tag retention 6/16-17(28 hrs.) (211/217)

9) tag retention 6/28-29(166/169)

10) tag retention 6/22-23(161/165)

11) tag retention 6/25-7/18(230/235)

Table 19: 1976-77 Fish Creek growth prediction data for April 20 and May 20, 1977  
by fork length (mm) for coded wire tagging

Pen #	Mean Length March 9, '77	March 9, '77 Predicted Standard Deviation	Predicted Length April 20, '77	Mean Length April 12, '77	Predicted Length May 20, '77	Pre-tag Sample
1	121.6	10.8	124.8	120.5	128.0	
2	122.3	11.0	126.8	125.4	131.3	129.1(4/29/77)
3	123.4	10.2	129.8	121.1	136.2	
4	121.6	10.7	125.1	122.7	127.8	
5	121.4	9.7	126.7	119.9	132.0	
7	106.0	8.5	107.1	110.6	108.2	115.9(4/28/77)
8	121.6	10.4	124.1	123.8	126.6	133.0(5/4/77)
9	139.4	15.0	148.7	147.6	157.0	149.2(5/9/77)
Average Length	121.6*			123.5*		

- Notes:
- A) Pen #1 was on dry food, tagged separately (code 4-16-39)
  - B) Pen # 7 was returned to Sport Fish Division at 115.9 mm and 59.6 fish/kg
  - C) Pen # 9 were "big fish" tagged separately (code 4-16-51) and released 5/9/77 at 149.2 mm and 25.1 fish/kg
  - D) The sick fish tagged were obtained by sorting through all pens (code 4-16-5)
  - E) Pens # 3,4,& 5 were used for April 20th tag release (code 4-16-4)
  - F) Pens # 2,4, & 8 were used for May 20th tag release (code 4-16-6; pen # 4 supplied for fish for both releases)
  - G) "Big fish" were released 5/9/77 at 149.2 mm and 25.1 fish/kg

\* weighted average

(Kennedy, 1975) is being adapted (Figure 23) for the facility to replace the aluminum frames. The new design calls for concrete weights on each corner of the floating collar to be the supportive mechanism for the rearing nets. With the new frame design, (1) initial cost is reduced (\$150 vs. \$1,500), (2) corrosion and abrasion problems are decreased, (3) and the pen is easier to work with during cleaning and sampling. Several aluminum net frames may be needed to transport fish from shore to the facility. However, recently a fish shipment was received and the rope pen design was utilized for fish transport with no apparent problem. Further towing of nets without a rigid below water supportive structure will be conducted to determine if the aluminum frames may be eliminated.

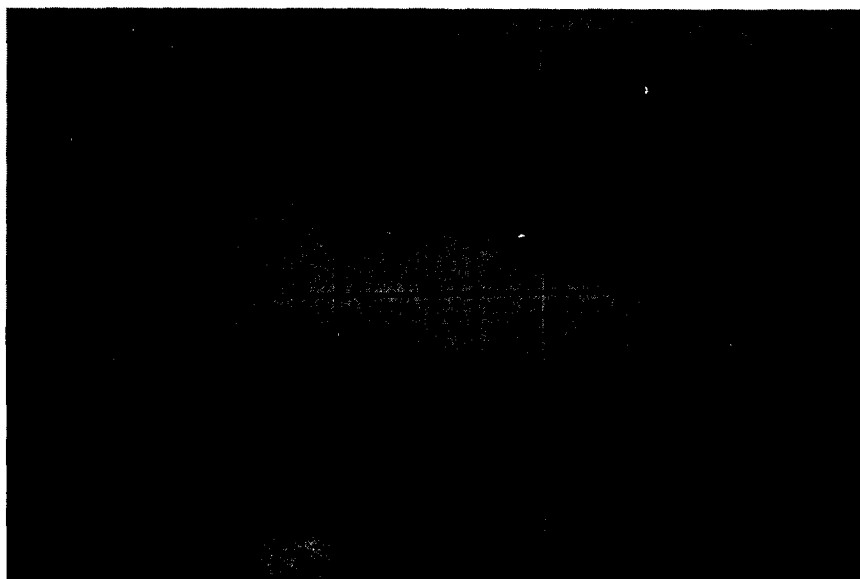


Figure 19: Aluminum net frame.

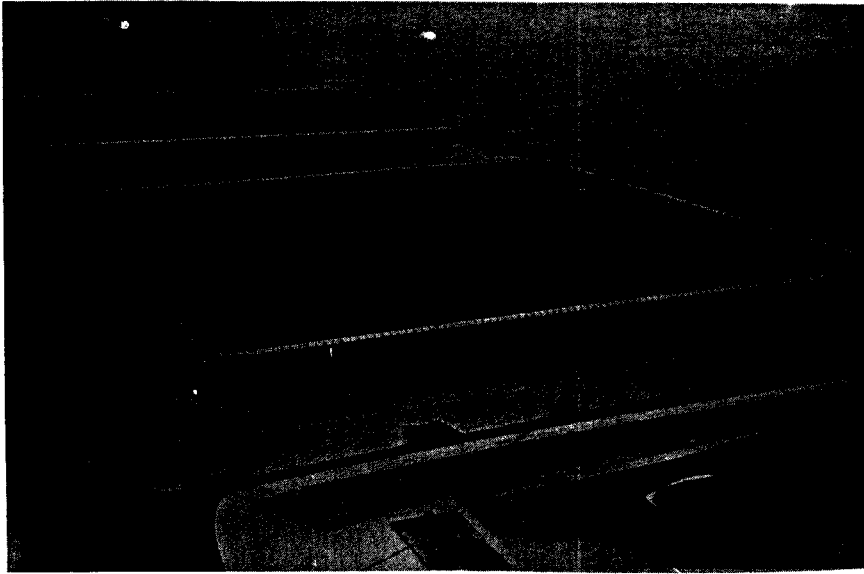


Figure 20: Net pen collar of creosoted wood and styrofoam logs.



Figure 21: Barnacle growth on net pen frame.



Figure 22: Corroded aluminum net frame castings.

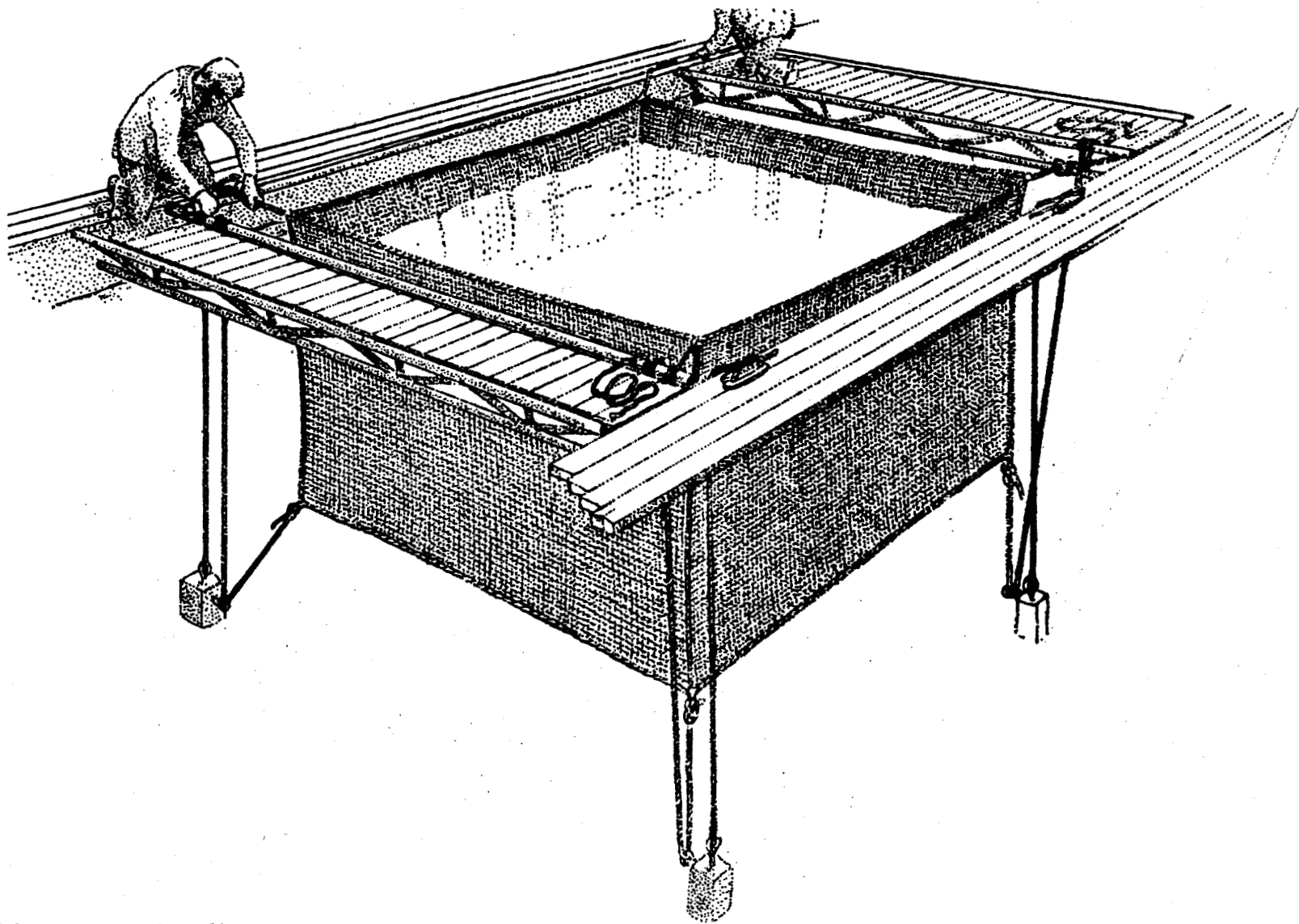


Figure 23: Canadian net pen support structure (Kennedy, 1975).



## Antifouling Compounds

Accumulation of marine plant growth on underwater rearing components greatly reduces water exchange in the rearing pens through blockage of the .63 cm mesh holes. To prevent the growth of diatom colonies, brown algae (Alana sp.), and barnacles (Balanus sp.) a copper antifouling paint (18% copper) was acquired from Tess Fish Farming Systems, Starvanger, Norway and applied to one net for experimental purposes. Results show minimal plant growth on the experimental net versus non-treated nets (test period in excess of 6 months). All untreated nets were washed with high pressure hoses once every week to ten days to combat fouling. Clean net mesh permits water circulation that is needed for waste removal and sufficient oxygen supply. The net painted with antifouling paint was washed only every four to six weeks. Tissue samples from the fish reared in the treated net were tested to determine if a higher than average copper residue existed in them as compared to control fish. Test results indicated no significant difference with 7 ppm and 10 ppm respectively for test and control lots. This antifouling practice is routine in many European fish farming facilities that raise pan size fish for the commercial market and it therefore appears unlikely that toxic levels of copper would exist unnoticed. Even minute amounts of copper are toxic to fish especially in conjunction with other heavy metals (Bell, 1973).

## DISCUSSION

### Grading

Consultation with local and regional staff and a literature survey demonstrated the need for grading to resolve conflicting reports on the subject. The extremes in size frequency distribution, observations of cannibalism (obvious on dead fish), dominance in the feeding response shown by the larger fish, and the desire to test the hypothesis "that better conversion (food fed/weight gain) will occur in pens of fish exhibiting less size variation" were additional reasons for experimental grading. According to Cortland Hatchery Reports Nos. 32 and 34 "grading provides uniform sized fish which enables more efficient sampling, reduces cannibalism and increases growth in populations more the same size". However the hypotheses put forward in the Cortland reports were not proven in Cortland Hatchery Report No. 34. Wood (1974) stated that size variations in a population may be the result of excessive fish handling and/or chronic disease problems.

The large size variation in the coho is theoretically due to chronic disease problems known to exist in this population of fish due to their exposure at Crystal Lake to bacterial kidney disease (BKD), nitrogen supersaturation and frequent handling. BKD was shown to exist in the fish at Fish Creek on several instances when samples were sent to the F.R.E.D. pathology laboratory in Anchorage. The BKD organism is a gram positive diplobacilli for which no cure is presently known; however, the literature shows treatment with erythromycin and tetracycline is in some instances helpful (Brunson, 1976 and Parrish, 1976).

A thorough analysis of growth and survival prior to and after grading has not occurred. Further grading trials in 1977-78 may help answer these questions.

#### Growth, Survival, and Food Conversions

Data obtained from growth food conversion indicates the coho were either (1) overfed or (2) poor converters. Information from Table 8 indicates coho salmon increased in length by 12.4% and the rainbow trout by 49.9%. The rainbow trout were better converters than the coho salmon even though the trout lost 59.2% of the original number stocked versus 24.1% for the coho. The poor conversions for the coho can be expected due to (1) disease problems and (2) cold water temperatures. Whether the trout were better adapted to the cold water than the salmon is not known. Data obtained for growth and food conversions in 1976-77 at Fish Creek has caused serious consideration of reducing the feeding ration during the 1977-78 rearing season.

#### New Net Pen Design

Because of preliminary work done in 1976-77 all 49m<sup>3</sup> pens at Fish Creek will undergo modification to eliminate the under water metal net support structure. Corner weights of concrete (34 kg each) will support the net.

#### Antifouling Compounds

All nets for 1977-78 will be coated with an antifouling compound tested in 1976-77 and found to be nontoxic to reared fish. The application of the antifouling compound will allow better water circulation for waste removal and oxygen supply. Time spent maintaining the net pens will be reduced since net cleaning will need to be done less often.

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